

## DER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

### Property Address: GT 002 - Be Lean

**Address :** GT 002, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	72	(1a) x	2.9	(2a) =	208.8
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	72	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	208.8

### 2. Ventilation rate:

	main heating		secondary heating		other		total		m <sup>3</sup> per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0
Number of open flues	0	+	0	+	0	=	0	x 20 =	0
Number of intermittent fans							0	x 10 =	0
Number of passive vents							0	x 10 =	0
Number of flueless gas fires							0	x 40 =	0

### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 0 ÷ (5) = 0 (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 0 [(9)-1]x0.1 = (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction  
*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  $0.25 - [0.2 \times (14) \div 100] =$  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 2 (17)

If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) 0.1 (18)

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

Number of sides sheltered 2 (19)

Shelter factor  $(20) = 1 - [0.075 \times (19)] =$  0.85 (20)

Infiltration rate incorporating shelter factor  $(21) = (18) \times (20) =$  0.08 (21)

Infiltration rate modified for monthly wind speed

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

(22)m=

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

(22a)m=

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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
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 (24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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 (24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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 (24d)

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

(25)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
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 (25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Doors			3.89	x 1.4	= 5.446		(26)
Windows Type 1			3.43	x1/[1/( 1.4 )+ 0.04]	= 4.55		(27)
Windows Type 2			3.33	x1/[1/( 1.4 )+ 0.04]	= 4.41		(27)
Windows Type 3			3.43	x1/[1/( 1.4 )+ 0.04]	= 4.55		(27)
Windows Type 4			7.7	x1/[1/( 1.4 )+ 0.04]	= 10.21		(27)
Windows Type 5			2.65	x1/[1/( 1.4 )+ 0.04]	= 3.51		(27)
Floor			72	x 0.12	= 8.639999		(28)
Walls	83.2	27.76	55.44	x 0.12	= 6.65		(29)
Roof	9.02	0	9.02	x 0.1	= 0.9		(30)
Total area of elements, m <sup>2</sup>			164.22				(31)
Party wall			23.9	x 0	= 0		(32)

\* 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) =

53.29
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 (33)

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

0
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 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium

250
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 (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 

14.57
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 (36)

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

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

67.85
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 (37)

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Ventilation heat loss calculated monthly

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	15.56	15.42	15.27	14.54	14.39	13.66	13.66	13.51	13.95	14.39	14.69	14.98	(38)

Heat transfer coefficient, W/K

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

(39)m=	83.42	83.27	83.12	82.39	82.25	81.51	81.51	81.37	81.81	82.25	82.54	82.83	
Average = Sum(39) <sub>1...12</sub> / 12 =												82.36	(39)

Heat loss parameter (HLP), W/m<sup>2</sup>K

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

(40)m=	1.16	1.16	1.15	1.14	1.14	1.13	1.13	1.13	1.14	1.14	1.15	1.15	
Average = Sum(40) <sub>1...12</sub> / 12 =												1.14	(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

2.29

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

if TFA ≤ 13.9, N = 1

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

88.68

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
<i>Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)</i>													
(44)m=	97.54	94	90.45	86.9	83.35	79.81	79.81	83.35	86.9	90.45	94	97.54	
Total = Sum(44) <sub>1...12</sub> =												1064.1	(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=	144.65	126.51	130.55	113.82	109.21	94.24	87.33	100.21	101.41	118.18	129	140.09	
Total = Sum(45) <sub>1...12</sub> =												1395.2	(45)

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

(46)m=	21.7	18.98	19.58	17.07	16.38	14.14	13.1	15.03	15.21	17.73	19.35	21.01	(46)
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Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
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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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	199.93	176.44	185.83	167.31	164.49	147.73	142.6	155.49	154.9	173.46	182.5	195.37	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	199.93	176.44	185.83	167.31	164.49	147.73	142.6	155.49	154.9	173.46	182.5	195.37	
Output from water heater (annual) <sub>1...12</sub>												2046.04	

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

(65)m=	92.32	82.01	87.63	80.64	80.53	74.13	73.26	77.54	76.51	83.52	85.69	90.8	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.68	114.68	114.68	114.68	114.68	114.68	114.68	114.68	114.68	114.68	114.68	114.68	(66)

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

(67)m=	18	15.99	13	9.84	7.36	6.21	6.71	8.73	11.71	14.87	17.36	18.5	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.92	204.01	198.73	187.49	173.3	159.97	151.06	148.96	154.24	165.48	179.67	193.01	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.47	34.47	34.47	34.47	34.47	34.47	34.47	34.47	34.47	34.47	34.47	34.47	(69)
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Pumps and fans gains (Table 5a)

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

(71)m=	-91.75	-91.75	-91.75	-91.75	-91.75	-91.75	-91.75	-91.75	-91.75	-91.75	-91.75	-91.75	(71)
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Water heating gains (Table 5)

(72)m=	124.08	122.04	117.78	112	108.24	102.96	98.46	104.22	106.27	112.25	119.01	122.04	(72)
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**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	401.41	399.44	386.92	366.74	346.31	326.54	313.64	319.32	329.63	350.01	373.45	390.96	(73)
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## 6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
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North	0.9x	0.77	x	3.33	x	10.63	x	0.4	x	0.8	=	15.7	(74)
North	0.9x	0.77	x	3.33	x	20.32	x	0.4	x	0.8	=	30.01	(74)
North	0.9x	0.77	x	3.33	x	34.53	x	0.4	x	0.8	=	51	(74)
North	0.9x	0.77	x	3.33	x	55.46	x	0.4	x	0.8	=	81.92	(74)
North	0.9x	0.77	x	3.33	x	74.72	x	0.4	x	0.8	=	110.35	(74)
North	0.9x	0.77	x	3.33	x	79.99	x	0.4	x	0.8	=	118.13	(74)
North	0.9x	0.77	x	3.33	x	74.68	x	0.4	x	0.8	=	110.29	(74)
North	0.9x	0.77	x	3.33	x	59.25	x	0.4	x	0.8	=	87.5	(74)
North	0.9x	0.77	x	3.33	x	41.52	x	0.4	x	0.8	=	61.32	(74)
North	0.9x	0.77	x	3.33	x	24.19	x	0.4	x	0.8	=	35.73	(74)
North	0.9x	0.77	x	3.33	x	13.12	x	0.4	x	0.8	=	19.37	(74)
North	0.9x	0.77	x	3.33	x	8.86	x	0.4	x	0.8	=	13.09	(74)
East	0.9x	0.77	x	3.43	x	19.64	x	0.4	x	0.8	=	14.94	(76)
East	0.9x	0.77	x	3.43	x	38.42	x	0.4	x	0.8	=	29.22	(76)
East	0.9x	0.77	x	3.43	x	63.27	x	0.4	x	0.8	=	48.13	(76)
East	0.9x	0.77	x	3.43	x	92.28	x	0.4	x	0.8	=	70.19	(76)
East	0.9x	0.77	x	3.43	x	113.09	x	0.4	x	0.8	=	86.02	(76)
East	0.9x	0.77	x	3.43	x	115.77	x	0.4	x	0.8	=	88.06	(76)
East	0.9x	0.77	x	3.43	x	110.22	x	0.4	x	0.8	=	83.84	(76)
East	0.9x	0.77	x	3.43	x	94.68	x	0.4	x	0.8	=	72.01	(76)
East	0.9x	0.77	x	3.43	x	73.59	x	0.4	x	0.8	=	55.97	(76)
East	0.9x	0.77	x	3.43	x	45.59	x	0.4	x	0.8	=	34.68	(76)
East	0.9x	0.77	x	3.43	x	24.49	x	0.4	x	0.8	=	18.63	(76)
East	0.9x	0.77	x	3.43	x	16.15	x	0.4	x	0.8	=	12.29	(76)
South	0.9x	0.77	x	7.7	x	46.75	x	0.4	x	0.8	=	79.83	(78)
South	0.9x	0.77	x	2.65	x	46.75	x	0.4	x	0.8	=	27.47	(78)
South	0.9x	0.77	x	7.7	x	76.57	x	0.4	x	0.8	=	130.74	(78)
South	0.9x	0.77	x	2.65	x	76.57	x	0.4	x	0.8	=	45	(78)
South	0.9x	0.77	x	7.7	x	97.53	x	0.4	x	0.8	=	166.54	(78)
South	0.9x	0.77	x	2.65	x	97.53	x	0.4	x	0.8	=	57.32	(78)
South	0.9x	0.77	x	7.7	x	110.23	x	0.4	x	0.8	=	188.23	(78)
South	0.9x	0.77	x	2.65	x	110.23	x	0.4	x	0.8	=	64.78	(78)
South	0.9x	0.77	x	7.7	x	114.87	x	0.4	x	0.8	=	196.15	(78)
South	0.9x	0.77	x	2.65	x	114.87	x	0.4	x	0.8	=	67.51	(78)
South	0.9x	0.77	x	7.7	x	110.55	x	0.4	x	0.8	=	188.77	(78)
South	0.9x	0.77	x	2.65	x	110.55	x	0.4	x	0.8	=	64.96	(78)
South	0.9x	0.77	x	7.7	x	108.01	x	0.4	x	0.8	=	184.44	(78)
South	0.9x	0.77	x	2.65	x	108.01	x	0.4	x	0.8	=	63.47	(78)
South	0.9x	0.77	x	7.7	x	104.89	x	0.4	x	0.8	=	179.11	(78)
South	0.9x	0.77	x	2.65	x	104.89	x	0.4	x	0.8	=	61.64	(78)
South	0.9x	0.77	x	7.7	x	101.89	x	0.4	x	0.8	=	173.97	(78)

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South	0.9x	0.77	x	2.65	x	101.89	x	0.4	x	0.8	=	59.87	(78)
South	0.9x	0.77	x	7.7	x	82.59	x	0.4	x	0.8	=	141.02	(78)
South	0.9x	0.77	x	2.65	x	82.59	x	0.4	x	0.8	=	48.53	(78)
South	0.9x	0.77	x	7.7	x	55.42	x	0.4	x	0.8	=	94.63	(78)
South	0.9x	0.77	x	2.65	x	55.42	x	0.4	x	0.8	=	32.57	(78)
South	0.9x	0.77	x	7.7	x	40.4	x	0.4	x	0.8	=	68.98	(78)
South	0.9x	0.77	x	2.65	x	40.4	x	0.4	x	0.8	=	23.74	(78)
West	0.9x	0.77	x	3.43	x	19.64	x	0.4	x	0.8	=	14.94	(80)
West	0.9x	0.77	x	3.43	x	38.42	x	0.4	x	0.8	=	29.22	(80)
West	0.9x	0.77	x	3.43	x	63.27	x	0.4	x	0.8	=	48.13	(80)
West	0.9x	0.77	x	3.43	x	92.28	x	0.4	x	0.8	=	70.19	(80)
West	0.9x	0.77	x	3.43	x	113.09	x	0.4	x	0.8	=	86.02	(80)
West	0.9x	0.77	x	3.43	x	115.77	x	0.4	x	0.8	=	88.06	(80)
West	0.9x	0.77	x	3.43	x	110.22	x	0.4	x	0.8	=	83.84	(80)
West	0.9x	0.77	x	3.43	x	94.68	x	0.4	x	0.8	=	72.01	(80)
West	0.9x	0.77	x	3.43	x	73.59	x	0.4	x	0.8	=	55.97	(80)
West	0.9x	0.77	x	3.43	x	45.59	x	0.4	x	0.8	=	34.68	(80)
West	0.9x	0.77	x	3.43	x	24.49	x	0.4	x	0.8	=	18.63	(80)
West	0.9x	0.77	x	3.43	x	16.15	x	0.4	x	0.8	=	12.29	(80)

Solar gains in watts, calculated for each month

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

(83)m=	152.89	264.2	371.12	475.31	546.05	547.98	525.87	472.29	407.12	294.63	183.82	130.38	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	554.3	663.64	758.04	842.05	892.36	874.53	839.52	791.6	736.74	644.64	557.27	521.35	(84)
--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

### 7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.9	0.76	0.58	0.42	0.47	0.71	0.93	0.99	1	(86)

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

(87)m=	19.9	20.1	20.38	20.68	20.89	20.98	21	20.99	20.94	20.66	20.22	19.86	(87)
--------	------	------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	------

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

(88)m=	19.95	19.95	19.96	19.96	19.97	19.97	19.97	19.98	19.97	19.97	19.96	19.96	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.87	0.71	0.49	0.33	0.37	0.62	0.9	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.51	18.8	19.19	19.62	19.87	19.96	19.97	19.97	19.93	19.6	18.98	18.46	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.38

 (91)

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

(92)m=	19.04	19.29	19.64	20.02	20.25	20.34	20.36	20.36	20.31	20	19.45	18.99	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	------

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

# DER WorkSheet: New dwelling design stage

(93)m=	19.04	19.29	19.64	20.02	20.25	20.34	20.36	20.36	20.31	20	19.45	18.99	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	------

## 8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, $h_m$ :													
(94)m=	0.99	0.98	0.94	0.87	0.72	0.52	0.36	0.4	0.65	0.9	0.98	0.99	(94)

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

(95)m=	548.56	647.8	716.18	730.6	644.85	459.02	305.21	320.1	481.5	580.58	544.88	517.22	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature,  $L_m$ ,  $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	1229.17	1198.55	1092.29	916.01	703.55	468.29	306.37	322.06	508.26	773.25	1019.01	1224.67	(97)
--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(98)m=	506.38	370.1	279.83	133.5	43.67	0	0	0	0	143.35	341.37	526.34	(98)
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$Total\ per\ year\ (kWh/year) = Sum(98)_{1...12} =$  2344.55 (98)

Space heating requirement in  $kWh/m^2/year$  32.56 (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.  
 Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

Fraction of heat from Community boilers 1 (303a)

Fraction of total space heat from Community boilers (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.1 (306)

**Space heating**  
 Annual space heating requirement 2344.55 **kWh/year**

Space heat from Community boilers (98) x (304a) x (305) x (306) = 2579 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0 (308)

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = 0 (309)

**Water heating**  
 Annual water heating requirement 2046.04

If DHW from community scheme:  
 Water heat from Community boilers (64) x (303a) x (305) x (306) = 2250.65 (310a)

Electricity used for heat distribution 0.01 x [(307a)...(307e) + (310a)...(310e)] = 48.3 (313)

Cooling System Energy Efficiency Ratio 0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0) = (107) ÷ (314) = 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):  
 mechanical ventilation - balanced, extract or positive input from outside 168.76 (330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	168.76	(331)
Energy for lighting (calculated in Appendix L)		317.91	(332)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	1098.11	(367)	
Electrical energy for heat distribution	[(313) x	0.52	=	25.07	(372)	
Total CO2 associated with community systems	(363)...(366) + (368)...(372)		=	1123.18	(373)	
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)	
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)	
Total CO2 associated with space and water heating	(373) + (374) + (375) =			1123.18	(376)	
CO2 associated with electricity for pumps and fans within dwelling	(331) x	0.52	=	87.59	(378)	
CO2 associated with electricity for lighting	(332)) x	0.52	=	164.99	(379)	
<b>Total CO2, kg/year</b>	sum of (376)...(382) =			1375.76	(383)	
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =			19.11	(384)	
<b>EI rating (section 14)</b>				84.24	(385)	



## TER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

Property Address: GT 002 - Be Lean

**Address :** GT 002, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	72	(1a) x	2.9	(2a) =	208.8 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	72	(4)			
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =				208.8 (5)

### 2. Ventilation rate:

	main heating		secondary heating		other		total		m <sup>3</sup> 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							3	x 10 =	30 (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) =	30	÷ (5) =	0.14 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration	[(9)-1]x0.1 =		0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.39 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.33 (21)
Infiltration rate modified for monthly wind speed			

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

(22)m =

5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

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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# TER WorkSheet: New dwelling design stage

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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:  (23a)

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

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

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

(24a)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58
------	------	------	------	------	------	------	------	------	------	------	------

(24d)

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

(25)m= 

0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58
------	------	------	------	------	------	------	------	------	------	------	------

(25)

**3. Heat losses and heat loss parameter:**

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Doors			<input type="text" value="3.89"/>	x <input type="text" value="1.2"/>	= <input type="text" value="4.668"/>		(26)
Windows Type 1			<input type="text" value="2.03"/>	x1/[1/( 1.4 )+ 0.04]	= <input type="text" value="2.69"/>		(27)
Windows Type 2			<input type="text" value="1.97"/>	x1/[1/( 1.4 )+ 0.04]	= <input type="text" value="2.61"/>		(27)
Windows Type 3			<input type="text" value="2.03"/>	x1/[1/( 1.4 )+ 0.04]	= <input type="text" value="2.69"/>		(27)
Windows Type 4			<input type="text" value="4.55"/>	x1/[1/( 1.4 )+ 0.04]	= <input type="text" value="6.03"/>		(27)
Windows Type 5			<input type="text" value="1.57"/>	x1/[1/( 1.4 )+ 0.04]	= <input type="text" value="2.08"/>		(27)
Floor			<input type="text" value="72"/>	x <input type="text" value="0.13"/>	= <input type="text" value="9.36"/>	<input type="text"/>	<input type="text"/> (28)
Walls	<input type="text" value="83.2"/>	<input type="text" value="18.01"/>	<input type="text" value="65.19"/>	x <input type="text" value="0.18"/>	= <input type="text" value="11.73"/>	<input type="text"/>	<input type="text"/> (29)
Roof	<input type="text" value="9.02"/>	<input type="text" value="0"/>	<input type="text" value="9.02"/>	x <input type="text" value="0.13"/>	= <input type="text" value="1.17"/>	<input type="text"/>	<input type="text"/> (30)
Total area of elements, m <sup>2</sup>			<input type="text" value="164.22"/>				(31)
Party wall			<input type="text" value="23.9"/>	x <input type="text" value="0"/>	= <input type="text" value="0"/>	<input type="text"/>	<input type="text"/> (32)

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

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

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

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium  (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  (36)

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

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

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Ventilation heat loss calculated monthly

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	40.72	40.48	40.24	39.12	38.91	37.93	37.93	37.75	38.31	38.91	39.33	39.78	(38)

Heat transfer coefficient, W/K

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

(39)m=	97.3	97.06	96.82	95.7	95.49	94.51	94.51	94.33	94.89	95.49	95.92	96.36	
Average = Sum(39) <sub>1...12</sub> /12=												95.7	(39)

Heat loss parameter (HLP), W/m<sup>2</sup>K

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

(40)m=	1.35	1.35	1.34	1.33	1.33	1.31	1.31	1.31	1.32	1.33	1.33	1.34	
Average = Sum(40) <sub>1...12</sub> /12=												1.33	(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

2.29

(42)

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

if TFA ≤ 13.9, N = 1

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

88.68

(43)

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

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

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

(44)m=	97.54	94	90.45	86.9	83.35	79.81	79.81	83.35	86.9	90.45	94	97.54	
Total = Sum(44) <sub>1...12</sub> =												1064.1	(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=	144.65	126.51	130.55	113.82	109.21	94.24	87.33	100.21	101.41	118.18	129	140.09	
Total = Sum(45) <sub>1...12</sub> =												1395.2	(45)

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

(46)m=	21.7	18.98	19.58	17.07	16.38	14.14	13.1	15.03	15.21	17.73	19.35	21.01	(46)
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Water storage loss:

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

150

(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):

1.39

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

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

0.75

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0.75

(55)

Water storage loss calculated for each month

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)
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# TER WorkSheet: New dwelling design stage

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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	191.25	168.6	177.15	158.91	155.81	139.33	133.92	146.8	146.5	164.77	174.09	186.68	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	191.25	168.6	177.15	158.91	155.81	139.33	133.92	146.8	146.5	164.77	174.09	186.68	
Output from water heater (annual) <sub>1...12</sub>												1943.82	(64)

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

(65)m=	85.37	75.73	80.68	73.92	73.59	67.41	66.31	70.6	69.79	76.57	78.97	83.86	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.68	114.68	114.68	114.68	114.68	114.68	114.68	114.68	114.68	114.68	114.68	114.68	(66)

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

(67)m=	18	15.99	13	9.84	7.36	6.21	6.71	8.73	11.71	14.87	17.36	18.5	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.92	204.01	198.73	187.49	173.3	159.97	151.06	148.96	154.24	165.48	179.67	193.01	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.47	34.47	34.47	34.47	34.47	34.47	34.47	34.47	34.47	34.47	34.47	34.47	(69)
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Pumps and fans gains (Table 5a)

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

(71)m=	-91.75	-91.75	-91.75	-91.75	-91.75	-91.75	-91.75	-91.75	-91.75	-91.75	-91.75	-91.75	(71)
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Water heating gains (Table 5)

(72)m=	114.75	112.7	108.45	102.66	98.91	93.62	89.13	94.89	96.93	102.92	109.68	112.71	(72)
--------	--------	-------	--------	--------	-------	-------	-------	-------	-------	--------	--------	--------	------

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

(73)m=	395.07	393.11	380.59	360.41	339.98	320.21	307.31	312.98	323.29	343.68	367.11	384.63	(73)
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## 6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
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## TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.97	x	10.63	x	0.63	x	0.7	=	12.8	(74)
North	0.9x	0.77	x	1.97	x	20.32	x	0.63	x	0.7	=	24.47	(74)
North	0.9x	0.77	x	1.97	x	34.53	x	0.63	x	0.7	=	41.58	(74)
North	0.9x	0.77	x	1.97	x	55.46	x	0.63	x	0.7	=	66.79	(74)
North	0.9x	0.77	x	1.97	x	74.72	x	0.63	x	0.7	=	89.97	(74)
North	0.9x	0.77	x	1.97	x	79.99	x	0.63	x	0.7	=	96.31	(74)
North	0.9x	0.77	x	1.97	x	74.68	x	0.63	x	0.7	=	89.92	(74)
North	0.9x	0.77	x	1.97	x	59.25	x	0.63	x	0.7	=	71.34	(74)
North	0.9x	0.77	x	1.97	x	41.52	x	0.63	x	0.7	=	49.99	(74)
North	0.9x	0.77	x	1.97	x	24.19	x	0.63	x	0.7	=	29.13	(74)
North	0.9x	0.77	x	1.97	x	13.12	x	0.63	x	0.7	=	15.8	(74)
North	0.9x	0.77	x	1.97	x	8.86	x	0.63	x	0.7	=	10.67	(74)
East	0.9x	0.77	x	2.03	x	19.64	x	0.63	x	0.7	=	12.18	(76)
East	0.9x	0.77	x	2.03	x	38.42	x	0.63	x	0.7	=	23.84	(76)
East	0.9x	0.77	x	2.03	x	63.27	x	0.63	x	0.7	=	39.25	(76)
East	0.9x	0.77	x	2.03	x	92.28	x	0.63	x	0.7	=	57.25	(76)
East	0.9x	0.77	x	2.03	x	113.09	x	0.63	x	0.7	=	70.16	(76)
East	0.9x	0.77	x	2.03	x	115.77	x	0.63	x	0.7	=	71.82	(76)
East	0.9x	0.77	x	2.03	x	110.22	x	0.63	x	0.7	=	68.38	(76)
East	0.9x	0.77	x	2.03	x	94.68	x	0.63	x	0.7	=	58.74	(76)
East	0.9x	0.77	x	2.03	x	73.59	x	0.63	x	0.7	=	45.65	(76)
East	0.9x	0.77	x	2.03	x	45.59	x	0.63	x	0.7	=	28.28	(76)
East	0.9x	0.77	x	2.03	x	24.49	x	0.63	x	0.7	=	15.19	(76)
East	0.9x	0.77	x	2.03	x	16.15	x	0.63	x	0.7	=	10.02	(76)
South	0.9x	0.77	x	4.55	x	46.75	x	0.63	x	0.7	=	65.01	(78)
South	0.9x	0.77	x	1.57	x	46.75	x	0.63	x	0.7	=	22.43	(78)
South	0.9x	0.77	x	4.55	x	76.57	x	0.63	x	0.7	=	106.47	(78)
South	0.9x	0.77	x	1.57	x	76.57	x	0.63	x	0.7	=	36.74	(78)
South	0.9x	0.77	x	4.55	x	97.53	x	0.63	x	0.7	=	135.62	(78)
South	0.9x	0.77	x	1.57	x	97.53	x	0.63	x	0.7	=	46.8	(78)
South	0.9x	0.77	x	4.55	x	110.23	x	0.63	x	0.7	=	153.29	(78)
South	0.9x	0.77	x	1.57	x	110.23	x	0.63	x	0.7	=	52.89	(78)
South	0.9x	0.77	x	4.55	x	114.87	x	0.63	x	0.7	=	159.73	(78)
South	0.9x	0.77	x	1.57	x	114.87	x	0.63	x	0.7	=	55.12	(78)
South	0.9x	0.77	x	4.55	x	110.55	x	0.63	x	0.7	=	153.72	(78)
South	0.9x	0.77	x	1.57	x	110.55	x	0.63	x	0.7	=	53.04	(78)
South	0.9x	0.77	x	4.55	x	108.01	x	0.63	x	0.7	=	150.19	(78)
South	0.9x	0.77	x	1.57	x	108.01	x	0.63	x	0.7	=	51.83	(78)
South	0.9x	0.77	x	4.55	x	104.89	x	0.63	x	0.7	=	145.86	(78)
South	0.9x	0.77	x	1.57	x	104.89	x	0.63	x	0.7	=	50.33	(78)
South	0.9x	0.77	x	4.55	x	101.89	x	0.63	x	0.7	=	141.68	(78)

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South	0.9x	0.77	x	1.57	x	101.89	x	0.63	x	0.7	=	48.89	(78)
South	0.9x	0.77	x	4.55	x	82.59	x	0.63	x	0.7	=	114.84	(78)
South	0.9x	0.77	x	1.57	x	82.59	x	0.63	x	0.7	=	39.63	(78)
South	0.9x	0.77	x	4.55	x	55.42	x	0.63	x	0.7	=	77.06	(78)
South	0.9x	0.77	x	1.57	x	55.42	x	0.63	x	0.7	=	26.59	(78)
South	0.9x	0.77	x	4.55	x	40.4	x	0.63	x	0.7	=	56.18	(78)
South	0.9x	0.77	x	1.57	x	40.4	x	0.63	x	0.7	=	19.38	(78)
West	0.9x	0.77	x	2.03	x	19.64	x	0.63	x	0.7	=	12.18	(80)
West	0.9x	0.77	x	2.03	x	38.42	x	0.63	x	0.7	=	23.84	(80)
West	0.9x	0.77	x	2.03	x	63.27	x	0.63	x	0.7	=	39.25	(80)
West	0.9x	0.77	x	2.03	x	92.28	x	0.63	x	0.7	=	57.25	(80)
West	0.9x	0.77	x	2.03	x	113.09	x	0.63	x	0.7	=	70.16	(80)
West	0.9x	0.77	x	2.03	x	115.77	x	0.63	x	0.7	=	71.82	(80)
West	0.9x	0.77	x	2.03	x	110.22	x	0.63	x	0.7	=	68.38	(80)
West	0.9x	0.77	x	2.03	x	94.68	x	0.63	x	0.7	=	58.74	(80)
West	0.9x	0.77	x	2.03	x	73.59	x	0.63	x	0.7	=	45.65	(80)
West	0.9x	0.77	x	2.03	x	45.59	x	0.63	x	0.7	=	28.28	(80)
West	0.9x	0.77	x	2.03	x	24.49	x	0.63	x	0.7	=	15.19	(80)
West	0.9x	0.77	x	2.03	x	16.15	x	0.63	x	0.7	=	10.02	(80)

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

(83)m=	124.62	215.35	302.51	387.46	445.14	446.72	428.7	385	331.86	240.16	149.83	106.27	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	519.69	608.46	683.1	747.87	785.12	766.93	736	697.98	655.15	583.84	516.94	490.9	(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=	1	0.99	0.98	0.95	0.86	0.71	0.55	0.59	0.82	0.96	0.99	1	(86)

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

(87)m=	19.61	19.79	20.07	20.43	20.74	20.92	20.98	20.97	20.85	20.45	19.96	19.58	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.8	19.8	19.81	19.82	19.82	19.83	19.83	19.83	19.83	19.82	19.82	19.81	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.92	0.81	0.61	0.41	0.46	0.73	0.94	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.97	18.24	18.65	19.16	19.57	19.78	19.82	19.82	19.71	19.21	18.5	17.93	(90)
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fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	18.59	18.83	19.19	19.64	20.01	20.21	20.26	20.26	20.14	19.68	19.05	18.55	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.59	18.83	19.19	19.64	20.01	20.21	20.26	20.26	20.14	19.68	19.05	18.55	(93)
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### 8. Space heating requirement

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

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

(94)m=	0.99	0.98	0.97	0.92	0.82	0.65	0.46	0.51	0.76	0.94	0.98	0.99	(94)
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Useful gains,  $h_m G_m$ ,  $W = (94)m \times (84)m$

(95)m=	515.49	598.62	659.78	688.53	645.38	494.97	339.84	354.43	497.93	547.34	508.8	487.76	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature,  $L_m$ ,  $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	1390.28	1351.71	1228.44	1027.88	793.17	530.41	345.95	363.76	573.17	866.68	1146.54	1382.99	(97)
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Space heating requirement for each month,  $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	650.85	506.08	423.08	244.33	109.95	0	0	0	0	237.59	459.17	666.05	
<b>Total per year (kWh/year) = Sum(98)<sub>1...5,9...12</sub> =</b>												3297.1	(98)

Space heating requirement in  $kWh/m^2/year$  45.79 (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 93.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

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

Space heating requirement (calculated above)

650.85	506.08	423.08	244.33	109.95	0	0	0	0	237.59	459.17	666.05
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(211)m =  $\{[(98)m \times (204)]\} \times 100 \div (206)$  (211)

(211)m=	696.09	541.26	452.49	261.32	117.6	0	0	0	0	254.11	491.09	712.35	
<b>Total (kWh/year) = Sum(211)<sub>1...5,10...12</sub> =</b>												3526.31	(211)

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

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

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	
<b>Total (kWh/year) = Sum(215)<sub>1...5,10...12</sub> =</b>												0	(215)

#### Water heating

Output from water heater (calculated above)

191.25	168.6	177.15	158.91	155.81	139.33	133.92	146.8	146.5	164.77	174.09	186.68
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Efficiency of water heater 79.8 (216)

(217)m= (217)

87.83	87.57	87.05	85.96	83.9	79.8	79.8	79.8	79.8	85.79	87.28	87.92
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Fuel for water heating,  $kWh/month$

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

(219)m=	217.76	192.54	203.49	184.87	185.69	174.6	167.82	183.97	183.58	192.07	199.46	212.34	
<b>Total = Sum(219a)<sub>1...12</sub> =</b>												2298.19	(219)

#### Annual totals

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

	3526.31	
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Water heating fuel used		2298.19
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		317.91 (232)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x		0.216	=	761.68 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)
Water heating	(219) x		0.216	=	496.41 (264)
Space and water heating	(261) + (262) + (263) + (264) =				1258.09 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93 (267)
Electricity for lighting	(232) x		0.519	=	164.99 (268)
Total CO2, kg/year		sum of (265)...(271) =			1462.01 (272)
 <b>TER =</b>					 20.31 (273)



# DER WorkSheet: New dwelling design stage

## User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

## Property Address: GT 004 - Be Lean

**Address :** GT 004, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )	
Ground floor	71.8	(1a) x	2.9	(2a) =	208.22 (3a)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.8					(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	208.22 (5)

### 2. Ventilation rate:

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

#### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0		÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Number of storeys in the dwelling (ns)				0 (9)
Additional infiltration				0 (10)
				[(9)-1]x0.1 =
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction				0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0				0 (12)
If no draught lobby, enter 0.05, else enter 0				0 (13)
Percentage of windows and doors draught stripped				0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =			0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =			0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area				2 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)				0.1 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>				
Number of sides sheltered				2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =			0.08 (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
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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# DER WorkSheet: New dwelling design stage

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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1
------	------	-----	------	------	------	------	------	------	------	-----	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24d)

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

(25)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (25)

**3. Heat losses and heat loss parameter:**

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Doors			3.89	x 1.4	= 5.446		(26)
Windows Type 1			3.43	x1/[1/( 1.4 )+ 0.04]	= 4.55		(27)
Windows Type 2			3.33	x1/[1/( 1.4 )+ 0.04]	= 4.41		(27)
Windows Type 3			3.43	x1/[1/( 1.4 )+ 0.04]	= 4.55		(27)
Windows Type 4			2.65	x1/[1/( 1.4 )+ 0.04]	= 3.51		(27)
Windows Type 5			2.65	x1/[1/( 1.4 )+ 0.04]	= 3.51		(27)
Floor			71.8	x 0.12	= 8.616		(28)
Walls	81.72	36.23	45.49	x 0.12	= 5.46		(29)
Roof	18.04	0	18.04	x 0.1	= 1.8		(30)
Total area of elements, m <sup>2</sup>			171.56				(31)
Party wall			54.23	x 0	= 0		(32)

\* 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) = 64.2 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 18.54 (36)

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

Total fabric heat loss (33) + (36) = 82.74 (37)

## DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	15.52	15.37	15.23	14.5	14.35	13.62	13.62	13.48	13.91	14.35	14.64	14.94	(38)

Heat transfer coefficient, W/K

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

(39)m=	98.26	98.11	97.96	97.23	97.09	96.36	96.36	96.21	96.65	97.09	97.38	97.67	
Average = Sum(39) <sub>1...12</sub> / 12 =												97.2	(39)

Heat loss parameter (HLP), W/m<sup>2</sup>K

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

(40)m=	1.37	1.37	1.36	1.35	1.35	1.34	1.34	1.34	1.35	1.35	1.36	1.36	
Average = Sum(40) <sub>1...12</sub> / 12 =												1.35	(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

2.29

(42)

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

if TFA ≤ 13.9, N = 1

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

88.56

(43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
<i>Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)</i>													
(44)m=	97.42	93.88	90.34	86.79	83.25	79.71	79.71	83.25	86.79	90.34	93.88	97.42	
Total = Sum(44) <sub>1...12</sub> =												1062.77	(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=	144.47	126.36	130.39	113.68	109.07	94.12	87.22	100.08	101.28	118.03	128.84	139.91	
Total = Sum(45) <sub>1...12</sub> =												1393.46	(45)

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

(46)m=	21.67	18.95	19.56	17.05	16.36	14.12	13.08	15.01	15.19	17.7	19.33	20.99	(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

110

(50)

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

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

0.02

(51)

If community heating see section 4.3

Volume factor from Table 2a

1.03

(52)

Temperature factor from Table 2b

0.6

(53)

Energy lost from water storage, kWh/year

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

1.03

(54)

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

1.03

(55)

Water storage loss calculated for each month

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

## DER WorkSheet: New dwelling design stage

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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(62)m=	199.75	176.28	185.66	167.17	164.35	147.62	142.5	155.36	154.77	173.31	182.34	195.19	(62)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	199.75	176.28	185.66	167.17	164.35	147.62	142.5	155.36	154.77	173.31	182.34	195.19	
Output from water heater (annual) <sub>1...12</sub>												2044.3	

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

(65)m=	92.26	81.96	87.58	80.59	80.49	74.09	73.22	77.5	76.47	83.47	85.63	90.74	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.45	114.45	114.45	114.45	114.45	114.45	114.45	114.45	114.45	114.45	114.45	114.45	(66)

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

(67)m=	17.96	15.95	12.97	9.82	7.34	6.2	6.7	8.71	11.68	14.84	17.32	18.46	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.46	203.55	198.28	187.07	172.91	159.61	150.72	148.63	153.89	165.11	179.27	192.57	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	34.45	34.45	34.45	34.45	34.45	34.45	34.45	34.45	34.45	34.45	34.45	34.45	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

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

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

(71)m=	-91.56	-91.56	-91.56	-91.56	-91.56	-91.56	-91.56	-91.56	-91.56	-91.56	-91.56	-91.56	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	124	121.96	117.71	111.93	108.18	102.9	98.42	104.17	106.21	112.19	118.94	121.97	(72)
--------	-----	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------	------

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

(73)m=	400.76	398.8	386.3	366.16	345.77	326.04	313.17	318.83	329.12	349.47	372.85	390.33	(73)
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### 6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
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## DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	3.33	x	10.63	x	0.4	x	0.8	=	31.41	(74)
North	0.9x	0.77	x	2.65	x	10.63	x	0.4	x	0.8	=	6.25	(74)
North	0.9x	0.77	x	3.33	x	20.32	x	0.4	x	0.8	=	60.02	(74)
North	0.9x	0.77	x	2.65	x	20.32	x	0.4	x	0.8	=	11.94	(74)
North	0.9x	0.77	x	3.33	x	34.53	x	0.4	x	0.8	=	102	(74)
North	0.9x	0.77	x	2.65	x	34.53	x	0.4	x	0.8	=	20.29	(74)
North	0.9x	0.77	x	3.33	x	55.46	x	0.4	x	0.8	=	163.83	(74)
North	0.9x	0.77	x	2.65	x	55.46	x	0.4	x	0.8	=	32.59	(74)
North	0.9x	0.77	x	3.33	x	74.72	x	0.4	x	0.8	=	220.7	(74)
North	0.9x	0.77	x	2.65	x	74.72	x	0.4	x	0.8	=	43.91	(74)
North	0.9x	0.77	x	3.33	x	79.99	x	0.4	x	0.8	=	236.26	(74)
North	0.9x	0.77	x	2.65	x	79.99	x	0.4	x	0.8	=	47	(74)
North	0.9x	0.77	x	3.33	x	74.68	x	0.4	x	0.8	=	220.58	(74)
North	0.9x	0.77	x	2.65	x	74.68	x	0.4	x	0.8	=	43.88	(74)
North	0.9x	0.77	x	3.33	x	59.25	x	0.4	x	0.8	=	175	(74)
North	0.9x	0.77	x	2.65	x	59.25	x	0.4	x	0.8	=	34.82	(74)
North	0.9x	0.77	x	3.33	x	41.52	x	0.4	x	0.8	=	122.63	(74)
North	0.9x	0.77	x	2.65	x	41.52	x	0.4	x	0.8	=	24.4	(74)
North	0.9x	0.77	x	3.33	x	24.19	x	0.4	x	0.8	=	71.45	(74)
North	0.9x	0.77	x	2.65	x	24.19	x	0.4	x	0.8	=	14.22	(74)
North	0.9x	0.77	x	3.33	x	13.12	x	0.4	x	0.8	=	38.75	(74)
North	0.9x	0.77	x	2.65	x	13.12	x	0.4	x	0.8	=	7.71	(74)
North	0.9x	0.77	x	3.33	x	8.86	x	0.4	x	0.8	=	26.18	(74)
North	0.9x	0.77	x	2.65	x	8.86	x	0.4	x	0.8	=	5.21	(74)
East	0.9x	0.77	x	3.43	x	19.64	x	0.4	x	0.8	=	29.88	(76)
East	0.9x	0.77	x	2.65	x	19.64	x	0.4	x	0.8	=	11.54	(76)
East	0.9x	0.77	x	3.43	x	38.42	x	0.4	x	0.8	=	58.45	(76)
East	0.9x	0.77	x	2.65	x	38.42	x	0.4	x	0.8	=	22.58	(76)
East	0.9x	0.77	x	3.43	x	63.27	x	0.4	x	0.8	=	96.26	(76)
East	0.9x	0.77	x	2.65	x	63.27	x	0.4	x	0.8	=	37.18	(76)
East	0.9x	0.77	x	3.43	x	92.28	x	0.4	x	0.8	=	140.38	(76)
East	0.9x	0.77	x	2.65	x	92.28	x	0.4	x	0.8	=	54.23	(76)
East	0.9x	0.77	x	3.43	x	113.09	x	0.4	x	0.8	=	172.04	(76)
East	0.9x	0.77	x	2.65	x	113.09	x	0.4	x	0.8	=	66.46	(76)
East	0.9x	0.77	x	3.43	x	115.77	x	0.4	x	0.8	=	176.12	(76)
East	0.9x	0.77	x	2.65	x	115.77	x	0.4	x	0.8	=	68.03	(76)
East	0.9x	0.77	x	3.43	x	110.22	x	0.4	x	0.8	=	167.67	(76)
East	0.9x	0.77	x	2.65	x	110.22	x	0.4	x	0.8	=	64.77	(76)
East	0.9x	0.77	x	3.43	x	94.68	x	0.4	x	0.8	=	144.03	(76)
East	0.9x	0.77	x	2.65	x	94.68	x	0.4	x	0.8	=	55.64	(76)
East	0.9x	0.77	x	3.43	x	73.59	x	0.4	x	0.8	=	111.95	(76)

## DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	2.65	x	73.59	x	0.4	x	0.8	=	43.25	(76)
East	0.9x	0.77	x	3.43	x	45.59	x	0.4	x	0.8	=	69.35	(76)
East	0.9x	0.77	x	2.65	x	45.59	x	0.4	x	0.8	=	26.79	(76)
East	0.9x	0.77	x	3.43	x	24.49	x	0.4	x	0.8	=	37.25	(76)
East	0.9x	0.77	x	2.65	x	24.49	x	0.4	x	0.8	=	14.39	(76)
East	0.9x	0.77	x	3.43	x	16.15	x	0.4	x	0.8	=	24.57	(76)
East	0.9x	0.77	x	2.65	x	16.15	x	0.4	x	0.8	=	9.49	(76)
West	0.9x	0.77	x	3.43	x	19.64	x	0.4	x	0.8	=	29.88	(80)
West	0.9x	0.77	x	3.43	x	38.42	x	0.4	x	0.8	=	58.45	(80)
West	0.9x	0.77	x	3.43	x	63.27	x	0.4	x	0.8	=	96.26	(80)
West	0.9x	0.77	x	3.43	x	92.28	x	0.4	x	0.8	=	140.38	(80)
West	0.9x	0.77	x	3.43	x	113.09	x	0.4	x	0.8	=	172.04	(80)
West	0.9x	0.77	x	3.43	x	115.77	x	0.4	x	0.8	=	176.12	(80)
West	0.9x	0.77	x	3.43	x	110.22	x	0.4	x	0.8	=	167.67	(80)
West	0.9x	0.77	x	3.43	x	94.68	x	0.4	x	0.8	=	144.03	(80)
West	0.9x	0.77	x	3.43	x	73.59	x	0.4	x	0.8	=	111.95	(80)
West	0.9x	0.77	x	3.43	x	45.59	x	0.4	x	0.8	=	69.35	(80)
West	0.9x	0.77	x	3.43	x	24.49	x	0.4	x	0.8	=	37.25	(80)
West	0.9x	0.77	x	3.43	x	16.15	x	0.4	x	0.8	=	24.57	(80)

Solar gains in watts, calculated for each month

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

(83)m=	108.96	211.44	351.98	531.42	675.16	703.54	664.58	553.51	414.18	251.17	135.36	90.03	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	509.72	610.24	738.29	897.58	1020.93	1029.58	977.75	872.35	743.3	600.63	508.21	480.36	(84)
--------	--------	--------	--------	--------	---------	---------	--------	--------	-------	--------	--------	--------	------

### 7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.91	0.76	0.57	0.43	0.49	0.77	0.96	0.99	1	(86)

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

(87)m=	19.57	19.77	20.12	20.54	20.84	20.97	20.99	20.99	20.88	20.45	19.93	19.54	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.79	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.8	19.8	19.8	19.79	(88)
--------	-------	-------	-------	------	------	-------	-------	-------	------	------	------	-------	------

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

(89)m=	0.99	0.99	0.96	0.88	0.7	0.48	0.31	0.37	0.68	0.94	0.99	1	(89)
--------	------	------	------	------	-----	------	------	------	------	------	------	---	------

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

(90)m=	17.92	18.21	18.7	19.29	19.66	19.79	19.81	19.8	19.72	19.19	18.44	17.87	(90)
--------	-------	-------	------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.39 (91)

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

(92)m=	18.56	18.81	19.25	19.78	20.12	20.24	20.27	20.26	20.17	19.68	19.02	18.51	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

# DER WorkSheet: New dwelling design stage

(93)m=	18.56	18.81	19.25	19.78	20.12	20.24	20.27	20.26	20.17	19.68	19.02	18.51	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

## 8. Space heating requirement

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

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

Utilisation factor for gains,  $h_m$ :

(94)m=	0.99	0.98	0.96	0.88	0.72	0.51	0.36	0.42	0.71	0.93	0.99	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	505.84	600.25	706.43	785.9	730.39	528.4	350.74	366.78	526.81	560.54	500.66	477.49	(95)
--------	--------	--------	--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

Heat loss rate for mean internal temperature,  $L_m$ ,  $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	1401.05	1365.05	1248.86	1057.65	817.36	543.87	353.18	371.59	586.45	881.3	1160.51	1397.96	(97)
--------	---------	---------	---------	---------	--------	--------	--------	--------	--------	-------	---------	---------	------

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

(98)m=	666.04	513.94	403.56	195.67	64.7	0	0	0	0	238.64	475.1	684.82	(98)
--------	--------	--------	--------	--------	------	---	---	---	---	--------	-------	--------	------

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

3242.48
---------

 (98)

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

45.16	(99)
-------	------

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 

0
---

 (301)

Fraction of space heat from community system 1 – (301) = 

1
---

 (302)

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

Fraction of heat from Community boilers 

1
---

 (303a)

Fraction of total space heat from Community boilers  $(302) \times (303a) =$ 

1
---

 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 

1
---

 (305)

Distribution loss factor (Table 12c) for community heating system 

1.1
-----

 (306)

### Space heating

Annual space heating requirement 

3242.48
---------

**kWh/year**

Space heat from Community boilers  $(98) \times (304a) \times (305) \times (306) =$ 

3566.73
---------

 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 

0
---

 (308)

Space heating requirement from secondary/supplementary system  $(98) \times (301) \times 100 \div (308) =$ 

0
---

 (309)

### Water heating

Annual water heating requirement 

2044.3
--------

If DHW from community scheme:  
Water heat from Community boilers  $(64) \times (303a) \times (305) \times (306) =$ 

2248.73
---------

 (310a)

Electricity used for heat distribution  $0.01 \times [(307a)...(307e) + (310a)...(310e)] =$ 

58.15
-------

 (313)

Cooling System Energy Efficiency Ratio 

0
---

 (314)

Space cooling (if there is a fixed cooling system, if not enter 0)  $= (107) \div (314) =$ 

0
---

 (315)

Electricity for pumps and fans within dwelling (Table 4f):  
mechanical ventilation - balanced, extract or positive input from outside 

168.29
--------

 (330a)

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warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	168.29 (331)
Energy for lighting (calculated in Appendix L)		317.19 (332)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		95 (367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	= 1322.25 (367)
Electrical energy for heat distribution	[(313) x	0.52	= 30.18 (372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)		= 1352.43 (373)
CO2 associated with space heating (secondary)	(309) x	0	= 0 (374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	= 0 (375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =		1352.43 (376)
CO2 associated with electricity for pumps and fans within dwelling	(331) x	0.52	= 87.34 (378)
CO2 associated with electricity for lighting	(332)) x	0.52	= 164.62 (379)
<b>Total CO2, kg/year</b>	sum of (376)...(382) =		1604.4 (383)
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =		22.35 (384)
<b>EI rating (section 14)</b>			81.59 (385)



## TER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

### Property Address: GT 004 - Be Lean

**Address :** GT 004, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	71.8	(1a) x	2.9	(2a) =	208.22 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.8	(4)			
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =				208.22 (5)

### 2. Ventilation rate:

	main heating		secondary heating		other		total		m <sup>3</sup> 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							3	x 10 =	30 (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) =	30	÷ (5) =	0.14 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration			0 (10)
			[(9)-1]x0.1 =
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.39 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.33 (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

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

<b>(22a)m=</b>	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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# TER WorkSheet: New dwelling design stage

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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58
------	------	------	------	------	------	------	------	------	------	------	------

 (24d)

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

(25)m= 

0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58
------	------	------	------	------	------	------	------	------	------	------	------

 (25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Doors			3.89	x 1.2	= 4.668		(26)
Windows Type 1			1.49	x1/[1/( 1.4 )+ 0.04]	= 1.98		(27)
Windows Type 2			1.45	x1/[1/( 1.4 )+ 0.04]	= 1.92		(27)
Windows Type 3			1.49	x1/[1/( 1.4 )+ 0.04]	= 1.98		(27)
Windows Type 4			1.15	x1/[1/( 1.4 )+ 0.04]	= 1.52		(27)
Windows Type 5			1.15	x1/[1/( 1.4 )+ 0.04]	= 1.52		(27)
Floor			71.8	x 0.13	= 9.334		(28)
Walls	81.72	17.95	63.77	x 0.18	= 11.48		(29)
Roof	18.04	0	18.04	x 0.13	= 2.35		(30)
Total area of elements, m <sup>2</sup>			171.56				(31)
Party wall			54.23	x 0	= 0		(32)

\* 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) =

46.47
-------

 (33)

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

0
---

 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium

250
-----

 (35)

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

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

12.72
-------

 (36)

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

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

59.19
-------

 (37)

## TER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	40.62	40.38	40.14	39.02	38.81	37.84	37.84	37.65	38.21	38.81	39.24	39.68	(38)

Heat transfer coefficient, W/K

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

(39)m=	99.81	99.57	99.33	98.21	98	97.02	97.02	96.84	97.4	98	98.42	98.86	
Average = Sum(39) <sub>1...12</sub> /12=												98.21	(39)

Heat loss parameter (HLP), W/m<sup>2</sup>K

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

(40)m=	1.39	1.39	1.38	1.37	1.36	1.35	1.35	1.35	1.36	1.36	1.37	1.38	
Average = Sum(40) <sub>1...12</sub> /12=												1.37	(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

2.29

(42)

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

if TFA ≤ 13.9, N = 1

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

88.56

(43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	97.42	93.88	90.34	86.79	83.25	79.71	79.71	83.25	86.79	90.34	93.88	97.42	
Total = Sum(44) <sub>1...12</sub> =												1062.77	(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=	144.47	126.36	130.39	113.68	109.07	94.12	87.22	100.08	101.28	118.03	128.84	139.91	
Total = Sum(45) <sub>1...12</sub> =												1393.46	(45)

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

(46)m=	21.67	18.95	19.56	17.05	16.36	14.12	13.08	15.01	15.19	17.7	19.33	20.99	(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (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) 0.75 (55)

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)
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# TER WorkSheet: New dwelling design stage

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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(62)m=	191.07	168.44	176.98	158.77	155.67	139.21	133.81	146.68	146.37	164.63	173.93	186.51	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	191.07	168.44	176.98	158.77	155.67	139.21	133.81	146.68	146.37	164.63	173.93	186.51	
Output from water heater (annual) <sup>1...12</sup>												1942.08	(64)

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

(65)m=	85.31	75.68	80.63	73.87	73.54	67.37	66.28	70.55	69.75	76.52	78.91	83.8	(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=	114.45	114.45	114.45	114.45	114.45	114.45	114.45	114.45	114.45	114.45	114.45	114.45	(66)

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

(67)m=	17.96	15.95	12.97	9.82	7.34	6.2	6.7	8.71	11.68	14.84	17.32	18.46	(67)
--------	-------	-------	-------	------	------	-----	-----	------	-------	-------	-------	-------	------

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

(68)m=	201.46	203.55	198.28	187.07	172.91	159.61	150.72	148.63	153.89	165.11	179.27	192.57	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	34.45	34.45	34.45	34.45	34.45	34.45	34.45	34.45	34.45	34.45	34.45	34.45	(69)
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Pumps and fans gains (Table 5a)

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

(71)m=	-91.56	-91.56	-91.56	-91.56	-91.56	-91.56	-91.56	-91.56	-91.56	-91.56	-91.56	-91.56	(71)
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Water heating gains (Table 5)

(72)m=	114.67	112.62	108.37	102.6	98.85	93.57	89.08	94.83	96.87	102.85	109.6	112.63	(72)
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**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	394.42	392.46	379.97	359.82	339.44	319.71	306.83	312.5	322.79	343.13	366.52	384	(73)
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## 6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
--------------	---------------------------	------------------------	------------------	----------------	----------------	--------------

## TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	=	18.85	(74)
North	0.9x	0.77	x	1.15	x	10.63	x	0.63	x	0.7	=	3.74	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	=	36.02	(74)
North	0.9x	0.77	x	1.15	x	20.32	x	0.63	x	0.7	=	7.14	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	=	61.21	(74)
North	0.9x	0.77	x	1.15	x	34.53	x	0.63	x	0.7	=	12.14	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	=	98.31	(74)
North	0.9x	0.77	x	1.15	x	55.46	x	0.63	x	0.7	=	19.49	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	=	132.44	(74)
North	0.9x	0.77	x	1.15	x	74.72	x	0.63	x	0.7	=	26.26	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	=	141.78	(74)
North	0.9x	0.77	x	1.15	x	79.99	x	0.63	x	0.7	=	28.11	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	=	132.37	(74)
North	0.9x	0.77	x	1.15	x	74.68	x	0.63	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	=	105.02	(74)
North	0.9x	0.77	x	1.15	x	59.25	x	0.63	x	0.7	=	20.82	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	=	73.59	(74)
North	0.9x	0.77	x	1.15	x	41.52	x	0.63	x	0.7	=	14.59	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	=	42.88	(74)
North	0.9x	0.77	x	1.15	x	24.19	x	0.63	x	0.7	=	8.5	(74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	23.25	(74)
North	0.9x	0.77	x	1.15	x	13.12	x	0.63	x	0.7	=	4.61	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	1.15	x	8.86	x	0.63	x	0.7	=	3.12	(74)
East	0.9x	0.77	x	1.49	x	19.64	x	0.63	x	0.7	=	17.89	(76)
East	0.9x	0.77	x	1.15	x	19.64	x	0.63	x	0.7	=	6.9	(76)
East	0.9x	0.77	x	1.49	x	38.42	x	0.63	x	0.7	=	34.99	(76)
East	0.9x	0.77	x	1.15	x	38.42	x	0.63	x	0.7	=	13.5	(76)
East	0.9x	0.77	x	1.49	x	63.27	x	0.63	x	0.7	=	57.62	(76)
East	0.9x	0.77	x	1.15	x	63.27	x	0.63	x	0.7	=	22.24	(76)
East	0.9x	0.77	x	1.49	x	92.28	x	0.63	x	0.7	=	84.04	(76)
East	0.9x	0.77	x	1.15	x	92.28	x	0.63	x	0.7	=	32.43	(76)
East	0.9x	0.77	x	1.49	x	113.09	x	0.63	x	0.7	=	103	(76)
East	0.9x	0.77	x	1.15	x	113.09	x	0.63	x	0.7	=	39.75	(76)
East	0.9x	0.77	x	1.49	x	115.77	x	0.63	x	0.7	=	105.44	(76)
East	0.9x	0.77	x	1.15	x	115.77	x	0.63	x	0.7	=	40.69	(76)
East	0.9x	0.77	x	1.49	x	110.22	x	0.63	x	0.7	=	100.38	(76)
East	0.9x	0.77	x	1.15	x	110.22	x	0.63	x	0.7	=	38.74	(76)
East	0.9x	0.77	x	1.49	x	94.68	x	0.63	x	0.7	=	86.22	(76)
East	0.9x	0.77	x	1.15	x	94.68	x	0.63	x	0.7	=	33.27	(76)
East	0.9x	0.77	x	1.49	x	73.59	x	0.63	x	0.7	=	67.02	(76)

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East	0.9x	0.77	x	1.15	x	73.59	x	0.63	x	0.7	=	25.86	(76)
East	0.9x	0.77	x	1.49	x	45.59	x	0.63	x	0.7	=	41.52	(76)
East	0.9x	0.77	x	1.15	x	45.59	x	0.63	x	0.7	=	16.02	(76)
East	0.9x	0.77	x	1.49	x	24.49	x	0.63	x	0.7	=	22.3	(76)
East	0.9x	0.77	x	1.15	x	24.49	x	0.63	x	0.7	=	8.61	(76)
East	0.9x	0.77	x	1.49	x	16.15	x	0.63	x	0.7	=	14.71	(76)
East	0.9x	0.77	x	1.15	x	16.15	x	0.63	x	0.7	=	5.68	(76)
West	0.9x	0.77	x	1.49	x	19.64	x	0.63	x	0.7	=	17.89	(80)
West	0.9x	0.77	x	1.49	x	38.42	x	0.63	x	0.7	=	34.99	(80)
West	0.9x	0.77	x	1.49	x	63.27	x	0.63	x	0.7	=	57.62	(80)
West	0.9x	0.77	x	1.49	x	92.28	x	0.63	x	0.7	=	84.04	(80)
West	0.9x	0.77	x	1.49	x	113.09	x	0.63	x	0.7	=	103	(80)
West	0.9x	0.77	x	1.49	x	115.77	x	0.63	x	0.7	=	105.44	(80)
West	0.9x	0.77	x	1.49	x	110.22	x	0.63	x	0.7	=	100.38	(80)
West	0.9x	0.77	x	1.49	x	94.68	x	0.63	x	0.7	=	86.22	(80)
West	0.9x	0.77	x	1.49	x	73.59	x	0.63	x	0.7	=	67.02	(80)
West	0.9x	0.77	x	1.49	x	45.59	x	0.63	x	0.7	=	41.52	(80)
West	0.9x	0.77	x	1.49	x	24.49	x	0.63	x	0.7	=	22.3	(80)
West	0.9x	0.77	x	1.49	x	16.15	x	0.63	x	0.7	=	14.71	(80)

Solar gains in watts, calculated for each month

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

(83)m=	65.26	126.65	210.83	318.32	404.44	421.45	398.11	331.56	248.08	150.44	81.07	53.92	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	459.69	519.11	590.8	678.15	743.87	741.16	704.94	644.06	570.87	493.57	447.59	437.92	(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=	1	0.99	0.99	0.96	0.89	0.74	0.58	0.64	0.88	0.98	0.99	1	(86)

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

(87)m=	19.49	19.64	19.93	20.33	20.68	20.91	20.98	20.96	20.78	20.32	19.84	19.46	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.77	19.77	19.78	19.79	19.79	19.8	19.8	19.8	19.8	19.79	19.79	19.78	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.95	0.84	0.64	0.43	0.5	0.8	0.97	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.78	18	18.42	19	19.48	19.74	19.79	19.79	19.62	19.01	18.3	17.75	(90)
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fLA = Living area ÷ (4) = 0.39 (91)

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

(92)m=	18.44	18.63	19	19.51	19.95	20.19	20.25	20.24	20.07	19.52	18.9	18.41	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.44	18.63	19	19.51	19.95	20.19	20.25	20.24	20.07	19.52	18.9	18.41	(93)
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### 8. Space heating requirement

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

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

(94)m=	0.99	0.99	0.98	0.94	0.85	0.67	0.49	0.56	0.82	0.96	0.99	1	(94)
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Useful gains,  $h_m G_m$ ,  $W = (94)m \times (84)m$

(95)m=	457.27	514.26	578.3	638.21	629.76	497.67	345.58	357.49	469.63	475.27	443.33	436.05	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature,  $L_m$ ,  $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	1411.17	1367.47	1241.86	1042.25	808.07	542.42	354.16	372.02	581.43	874.01	1161.27	1405.19	(97)
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Space heating requirement for each month,  $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	709.7	573.35	493.69	290.91	132.66	0	0	0	0	296.66	516.92	721.04	
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Total per year (kWh/year) =  $Sum(98)_{1..5,9..12} =$  3734.93 (98)

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

													52.02	(99)
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### 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 93.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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Space heating requirement (calculated above)

709.7	573.35	493.69	290.91	132.66	0	0	0	0	296.66	516.92	721.04
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(211)m =  $\{[(98)m \times (204)]\} \times 100 \div (206)$  (211)

759.04	613.21	528.01	311.13	141.88	0	0	0	0	317.29	552.85	771.16
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Total (kWh/year) =  $Sum(211)_{1..5,10..12} =$  3994.58 (211)

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

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

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

#### Water heating

Output from water heater (calculated above)

191.07	168.44	176.98	158.77	155.67	139.21	133.81	146.68	146.37	164.63	173.93	186.51
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Efficiency of water heater 79.8 (216)

(217)m= 88 (217)

88	87.83	87.41	86.41	84.39	79.8	79.8	79.8	79.8	86.37	87.54	88.07
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Fuel for water heating,  $kWh/month$

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

(219)m=	217.13	191.79	202.48	183.74	184.46	174.45	167.69	183.81	183.42	190.61	198.68	211.77	
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Total =  $Sum(219a)_{1..12} =$  2290.03 (219)

#### Annual totals

Space heating fuel used, main system 1

**kWh/year**

**kWh/year**

													3994.58	
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Water heating fuel used		2290.03
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		317.19 (232)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x		0.216	=	862.83 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)
Water heating	(219) x		0.216	=	494.65 (264)
Space and water heating	(261) + (262) + (263) + (264) =				1357.48 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93 (267)
Electricity for lighting	(232) x		0.519	=	164.62 (268)
Total CO2, kg/year		sum of (265)...(271) =			1561.02 (272)
 <b>TER =</b>					 21.74 (273)



## DER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

### Property Address: GT 101 - Be Lean

**Address :** GT 101, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	68.2	(1a) x	2.6	(2a) =	177.32 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	68.2	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.32 (5)

### 2. Ventilation rate:

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

### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			2	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.1	(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.08	(21)

Infiltration rate modified for monthly wind speed

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

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

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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# DER WorkSheet: New dwelling design stage

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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24d)

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

(25)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (25)

**3. Heat losses and heat loss parameter:**

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			6.18	$x1/[1/(1.4)+0.04] =$	8.19		(27)
Windows Type 2			6.18	$x1/[1/(1.4)+0.04] =$	8.19		(27)
Windows Type 3			2.78	$x1/[1/(1.4)+0.04] =$	3.69		(27)
Windows Type 4			4.47	$x1/[1/(1.4)+0.04] =$	5.93		(27)
Windows Type 5			2.15	$x1/[1/(1.4)+0.04] =$	2.85		(27)
Floor			68.2	x 0.1 =	6.82		(28)
Walls	48.39	21.76	26.63	x 0.12 =	3.2		(29)
Total area of elements, m <sup>2</sup>			116.59				(31)
Party wall			39.03	x 0 =	0		(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 38.86 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.16 (36)

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

Total fabric heat loss (33) + (36) = 47.03 (37)

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

(38)m= 

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
13.22	13.09	12.97	12.35	12.22	11.6	11.6	11.48	11.85	12.22	12.47	12.72

 (38)

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

(39)m= 

60.24	60.12	59.99	59.37	59.25	58.63	58.63	58.5	58.87	59.25	59.5	59.74
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 (39)

# DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.88	0.88	0.88	0.87	0.87	0.86	0.86	0.86	0.86	0.87	0.87	0.88	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.87	(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 2.2 (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 86.49 (43)  
 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	95.14	91.68	88.22	84.76	81.3	77.84	77.84	81.3	84.76	88.22	91.68	95.14	(44)
Total = Sum(44) <sub>1...12</sub> =												1037.87	

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	141.09	123.4	127.33	111.01	106.52	91.92	85.18	97.74	98.91	115.27	125.82	136.64	(45)
Total = Sum(45) <sub>1...12</sub> =												1360.81	

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	21.16	18.51	19.1	16.65	15.98	13.79	12.78	14.66	14.84	17.29	18.87	20.5	(46)

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

If community heating and no tank in dwelling, enter 110 litres in (47)  
 Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:  
 Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3  
 Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)  
 Enter (50) or (54) in (55) 1.03 (55)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m  
 (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

## DER WorkSheet: New dwelling design stage

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(62)m=	196.36	173.32	182.61	164.51	161.8	145.41	140.45	153.02	152.4	170.54	179.32	191.91	(62)
--------	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	--------	------

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

(add additional lines if FGHS and/or WWHS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	196.36	173.32	182.61	164.51	161.8	145.41	140.45	153.02	152.4	170.54	179.32	191.91	(64)
Output from water heater (annual) <sub>1...12</sub>												2011.65	

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

(65)m=	91.13	80.97	86.56	79.71	79.64	73.36	72.54	76.72	75.68	82.55	84.63	89.65	(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=	110.08	110.08	110.08	110.08	110.08	110.08	110.08	110.08	110.08	110.08	110.08	110.08	(66)

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

(67)m=	17.21	15.29	12.43	9.41	7.04	5.94	6.42	8.34	11.2	14.22	16.59	17.69	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	193.06	195.06	190.01	179.27	165.7	152.95	144.43	142.43	147.48	158.22	171.79	184.54	(68)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	34.01	34.01	34.01	34.01	34.01	34.01	34.01	34.01	34.01	34.01	34.01	34.01	(69)
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Pumps and fans gains (Table 5a)

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

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

(71)m=	-88.07	-88.07	-88.07	-88.07	-88.07	-88.07	-88.07	-88.07	-88.07	-88.07	-88.07	-88.07	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	122.49	120.49	116.34	110.7	107.04	101.89	97.5	103.12	105.11	110.95	117.54	120.5	(72)
--------	--------	--------	--------	-------	--------	--------	------	--------	--------	--------	--------	-------	------

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

(73)m=	388.79	386.87	374.82	355.41	335.8	316.8	304.38	309.91	319.81	339.42	361.95	378.76	(73)
--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------	--------	------

### 6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub></sub> Table 6b	FF Table 6c	Gains (W)							
North	0.9x	0.77	x	2.78	x	10.63	x	0.4	x	0.8	=	6.56	(74)
North	0.9x	0.77	x	4.47	x	10.63	x	0.4	x	0.8	=	10.54	(74)
North	0.9x	0.77	x	2.15	x	10.63	x	0.4	x	0.8	=	5.07	(74)
North	0.9x	0.77	x	2.78	x	20.32	x	0.4	x	0.8	=	12.53	(74)
North	0.9x	0.77	x	4.47	x	20.32	x	0.4	x	0.8	=	20.14	(74)

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North	0.9x	0.77	x	2.15	x	20.32	x	0.4	x	0.8	=	9.69	(74)
North	0.9x	0.77	x	2.78	x	34.53	x	0.4	x	0.8	=	21.29	(74)
North	0.9x	0.77	x	4.47	x	34.53	x	0.4	x	0.8	=	34.23	(74)
North	0.9x	0.77	x	2.15	x	34.53	x	0.4	x	0.8	=	16.46	(74)
North	0.9x	0.77	x	2.78	x	55.46	x	0.4	x	0.8	=	34.19	(74)
North	0.9x	0.77	x	4.47	x	55.46	x	0.4	x	0.8	=	54.98	(74)
North	0.9x	0.77	x	2.15	x	55.46	x	0.4	x	0.8	=	26.44	(74)
North	0.9x	0.77	x	2.78	x	74.72	x	0.4	x	0.8	=	46.06	(74)
North	0.9x	0.77	x	4.47	x	74.72	x	0.4	x	0.8	=	74.06	(74)
North	0.9x	0.77	x	2.15	x	74.72	x	0.4	x	0.8	=	35.62	(74)
North	0.9x	0.77	x	2.78	x	79.99	x	0.4	x	0.8	=	49.31	(74)
North	0.9x	0.77	x	4.47	x	79.99	x	0.4	x	0.8	=	79.29	(74)
North	0.9x	0.77	x	2.15	x	79.99	x	0.4	x	0.8	=	38.14	(74)
North	0.9x	0.77	x	2.78	x	74.68	x	0.4	x	0.8	=	46.04	(74)
North	0.9x	0.77	x	4.47	x	74.68	x	0.4	x	0.8	=	74.02	(74)
North	0.9x	0.77	x	2.15	x	74.68	x	0.4	x	0.8	=	35.6	(74)
North	0.9x	0.77	x	2.78	x	59.25	x	0.4	x	0.8	=	36.52	(74)
North	0.9x	0.77	x	4.47	x	59.25	x	0.4	x	0.8	=	58.73	(74)
North	0.9x	0.77	x	2.15	x	59.25	x	0.4	x	0.8	=	28.25	(74)
North	0.9x	0.77	x	2.78	x	41.52	x	0.4	x	0.8	=	25.59	(74)
North	0.9x	0.77	x	4.47	x	41.52	x	0.4	x	0.8	=	41.15	(74)
North	0.9x	0.77	x	2.15	x	41.52	x	0.4	x	0.8	=	19.79	(74)
North	0.9x	0.77	x	2.78	x	24.19	x	0.4	x	0.8	=	14.91	(74)
North	0.9x	0.77	x	4.47	x	24.19	x	0.4	x	0.8	=	23.98	(74)
North	0.9x	0.77	x	2.15	x	24.19	x	0.4	x	0.8	=	11.53	(74)
North	0.9x	0.77	x	2.78	x	13.12	x	0.4	x	0.8	=	8.09	(74)
North	0.9x	0.77	x	4.47	x	13.12	x	0.4	x	0.8	=	13	(74)
North	0.9x	0.77	x	2.15	x	13.12	x	0.4	x	0.8	=	6.25	(74)
North	0.9x	0.77	x	2.78	x	8.86	x	0.4	x	0.8	=	5.46	(74)
North	0.9x	0.77	x	4.47	x	8.86	x	0.4	x	0.8	=	8.79	(74)
North	0.9x	0.77	x	2.15	x	8.86	x	0.4	x	0.8	=	4.23	(74)
West	0.9x	0.77	x	6.18	x	19.64	x	0.4	x	0.8	=	26.92	(80)
West	0.9x	0.77	x	6.18	x	19.64	x	0.4	x	0.8	=	26.92	(80)
West	0.9x	0.77	x	6.18	x	38.42	x	0.4	x	0.8	=	52.65	(80)
West	0.9x	0.77	x	6.18	x	38.42	x	0.4	x	0.8	=	52.65	(80)
West	0.9x	0.77	x	6.18	x	63.27	x	0.4	x	0.8	=	86.71	(80)
West	0.9x	0.77	x	6.18	x	63.27	x	0.4	x	0.8	=	86.71	(80)
West	0.9x	0.77	x	6.18	x	92.28	x	0.4	x	0.8	=	126.47	(80)
West	0.9x	0.77	x	6.18	x	92.28	x	0.4	x	0.8	=	126.47	(80)
West	0.9x	0.77	x	6.18	x	113.09	x	0.4	x	0.8	=	154.99	(80)
West	0.9x	0.77	x	6.18	x	113.09	x	0.4	x	0.8	=	154.99	(80)

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West	0.9x	0.77	x	6.18	x	115.77	x	0.4	x	0.8	=	158.66	(80)
West	0.9x	0.77	x	6.18	x	115.77	x	0.4	x	0.8	=	158.66	(80)
West	0.9x	0.77	x	6.18	x	110.22	x	0.4	x	0.8	=	151.05	(80)
West	0.9x	0.77	x	6.18	x	110.22	x	0.4	x	0.8	=	151.05	(80)
West	0.9x	0.77	x	6.18	x	94.68	x	0.4	x	0.8	=	129.75	(80)
West	0.9x	0.77	x	6.18	x	94.68	x	0.4	x	0.8	=	129.75	(80)
West	0.9x	0.77	x	6.18	x	73.59	x	0.4	x	0.8	=	100.85	(80)
West	0.9x	0.77	x	6.18	x	73.59	x	0.4	x	0.8	=	100.85	(80)
West	0.9x	0.77	x	6.18	x	45.59	x	0.4	x	0.8	=	62.48	(80)
West	0.9x	0.77	x	6.18	x	45.59	x	0.4	x	0.8	=	62.48	(80)
West	0.9x	0.77	x	6.18	x	24.49	x	0.4	x	0.8	=	33.56	(80)
West	0.9x	0.77	x	6.18	x	24.49	x	0.4	x	0.8	=	33.56	(80)
West	0.9x	0.77	x	6.18	x	16.15	x	0.4	x	0.8	=	22.13	(80)
West	0.9x	0.77	x	6.18	x	16.15	x	0.4	x	0.8	=	22.13	(80)

Solar gains in watts, calculated for each month

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

(83)m=	76	147.67	245.41	368.55	465.73	484.05	457.77	383	288.25	175.38	94.47	62.75	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	464.79	534.54	620.22	723.96	801.53	800.85	762.15	692.92	608.06	514.8	456.42	441.51	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

### 7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.96	0.86	0.67	0.47	0.34	0.39	0.65	0.93	0.99	1	(86)

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

(87)m=	20.21	20.36	20.6	20.86	20.98	21	21	21	20.98	20.8	20.46	20.18	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.18	20.18	20.18	20.19	20.19	20.2	20.2	20.2	20.2	20.19	20.19	20.19	(88)
--------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	------

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

(89)m=	0.99	0.99	0.95	0.83	0.62	0.41	0.28	0.32	0.58	0.9	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.13	19.35	19.69	20.04	20.17	20.2	20.2	20.2	20.19	19.97	19.49	19.09	(90)
--------	-------	-------	-------	-------	-------	------	------	------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.37 (91)

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

(92)m=	19.53	19.72	20.03	20.34	20.47	20.49	20.5	20.5	20.48	20.28	19.85	19.49	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.53	19.72	20.03	20.34	20.47	20.49	20.5	20.5	20.48	20.28	19.85	19.49	(93)
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### 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	
(94)m=	0.99	0.98	0.95	0.83	0.63	0.43	0.3	0.35	0.61	0.91	0.98	0.99	(94)

## DER WorkSheet: New dwelling design stage

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

(95)m=	461.47	525.56	588.61	604.11	507.22	344.62	228.31	239.46	368.76	466.1	448.84	439.13	(95)
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Monthly average external temperature from Table 8

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

(97)m=	917.54	891.22	811.7	679.41	519.48	345.54	228.38	239.64	375.67	573.35	758.37	913.77	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	339.31	245.72	165.97	54.21	9.12	0	0	0	0	79.8	222.86	353.13	
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Total per year (kWh/year) = Sum(98)<sub>1...5,9...12</sub> = 1470.13 (98)

Space heating requirement in kWh/m<sup>2</sup>/year

													(99)
												21.56	

### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

Fraction of heat from Community boilers 1 (303a)

Fraction of total space heat from Community boilers (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.1 (306)

#### Space heating

Annual space heating requirement 1470.13 kWh/year

Space heat from Community boilers (98) x (304a) x (305) x (306) = 1617.14 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0 (308)

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = 0 (309)

#### Water heating

Annual water heating requirement 2011.65 kWh/year

If DHW from community scheme:  
Water heat from Community boilers (64) x (303a) x (305) x (306) = 2212.81 (310a)

Electricity used for heat distribution 0.01 x [(307a)...(307e) + (310a)...(310e)] = 38.3 (313)

Cooling System Energy Efficiency Ratio 0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0) = (107) ÷ (314) = 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):  
mechanical ventilation - balanced, extract or positive input from outside 143.32 (330a)

warm air heating system fans 0 (330b)

pump for solar water heating 0 (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = 143.32 (331)

Energy for lighting (calculated in Appendix L) 303.96 (332)

### 12b. CO2 Emissions – Community heating scheme

Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
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## DER WorkSheet: New dwelling design stage

CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel	95			(367a)
CO2 associated with heat source 1	$[(307b)+(310b)] \times 100 \div (367b) \times$	0.22	=	870.81	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	19.88	(372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)		=	890.69	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			890.69	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331) x	0.52	=	74.38	(378)
CO2 associated with electricity for lighting	(332)) x	0.52	=	157.75	(379)
<b>Total CO2, kg/year</b>	sum of (376)...(382) =			1122.83	(383)
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =			16.46	(384)
<b>EI rating (section 14)</b>				86.71	(385)



## TER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

Property Address: GT 101 - Be Lean

**Address :** GT 101, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	68.2	(1a) ×	2.6	(2a) =	177.32 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	68.2	(4)			
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =				177.32 (5)

### 2. Ventilation rate:

	main heating		secondary heating		other		total		m <sup>3</sup> per hour
Number of chimneys	0	+	0	+	0	=	0	× 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	× 20 =	0 (6b)
Number of intermittent fans							2	× 10 =	20 (7a)
Number of passive vents							0	× 10 =	0 (7b)
Number of flueless gas fires							0	× 40 =	0 (7c)

#### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.11 (8)									
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>												
Number of storeys in the dwelling (ns)			0 (9)									
Additional infiltration			0 (10)									
		[(9)-1]×0.1 =	0 (11)									
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (12)									
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (13)									
If no draught lobby, enter 0.05, else enter 0			0 (14)									
Percentage of windows and doors draught stripped			0 (15)									
Window infiltration	0.25 - [0.2 × (14) ÷ 100] =		0 (16)									
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (17)									
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (18)									
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.36 (19)									
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>												
Number of sides sheltered			2 (20)									
Shelter factor	(20) = 1 - [0.075 × (19)] =		0.85 (21)									
Infiltration rate incorporating shelter factor	(21) = (18) × (20) =		0.31 (22)									
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

# TER WorkSheet: New dwelling design stage

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

0.39	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36
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Calculate effective air change rate for the applicable case

If mechanical ventilation:  (23a)

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

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

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

(24a)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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(24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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(24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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(24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.57
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(24d)

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

(25)m= 

0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.57
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(25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			<input type="text" value="4.84"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="6.42"/>		(27)
Windows Type 2			<input type="text" value="4.84"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="6.42"/>		(27)
Windows Type 3			<input type="text" value="2.18"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.89"/>		(27)
Windows Type 4			<input type="text" value="3.5"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="4.64"/>		(27)
Windows Type 5			<input type="text" value="1.68"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.23"/>		(27)
Floor			<input type="text" value="68.2"/>	$x$ <input type="text" value="0.13"/>	$=$ <input type="text" value="8.865999"/>	<input type="text"/>	(28)
Walls	<input type="text" value="48.39"/>	<input type="text" value="17.04"/>	<input type="text" value="31.35"/>	$x$ <input type="text" value="0.18"/>	$=$ <input type="text" value="5.64"/>	<input type="text"/>	(29)
Total area of elements, m <sup>2</sup>			<input type="text" value="116.59"/>				(31)
Party wall			<input type="text" value="39.03"/>	$x$ <input type="text" value="0"/>	$=$ <input type="text" value="0"/>	<input type="text"/>	(32)

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

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

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

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium  (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  (36)

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

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

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

(38)m= 

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
33.78	33.61	33.43	32.62	32.47	31.77	31.77	31.64	32.04	32.47	32.78	33.1

(38)

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

(39)m= 

76.32	76.15	75.98	75.17	75.02	74.31	74.31	74.18	74.58	75.02	75.32	75.64
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# TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1.12	1.12	1.11	1.1	1.1	1.09	1.09	1.09	1.09	1.1	1.1	1.11	
Average = Sum(40) <sub>1...12</sub> / 12 =												1.1	(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 2.2 (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 86.49 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	95.14	91.68	88.22	84.76	81.3	77.84	77.84	81.3	84.76	88.22	91.68	95.14	
Total = Sum(44) <sub>1...12</sub> =												1037.87	(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=	141.09	123.4	127.33	111.01	106.52	91.92	85.18	97.74	98.91	115.27	125.82	136.64	
Total = Sum(45) <sub>1...12</sub> =												1360.81	(45)

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

(46)m= 21.16 18.51 19.1 16.65 15.98 13.79 12.78 14.66 14.84 17.29 18.87 20.5 (46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (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) 0.75 (55)

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	
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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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	
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Primary circuit loss (annual) from Table 3 0 (58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	
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## TER WorkSheet: New dwelling design stage

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	187.68	165.48	173.93	156.1	153.11	137.01	131.77	144.33	144	161.86	170.91	183.23	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	187.68	165.48	173.93	156.1	153.11	137.01	131.77	144.33	144	161.86	170.91	183.23		
												Output from water heater (annual) <sub>1...12</sub>	(64)	
												1909.43		

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

(65)m=	84.19	74.7	79.61	72.98	72.69	66.64	65.6	69.77	68.96	75.6	77.91	82.71	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	110.08	110.08	110.08	110.08	110.08	110.08	110.08	110.08	110.08	110.08	110.08	110.08	(66)

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

(67)m=	17.21	15.29	12.43	9.41	7.04	5.94	6.42	8.34	11.2	14.22	16.59	17.69	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	193.06	195.06	190.01	179.27	165.7	152.95	144.43	142.43	147.48	158.22	171.79	184.54	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.01	34.01	34.01	34.01	34.01	34.01	34.01	34.01	34.01	34.01	34.01	34.01	(69)
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Pumps and fans gains (Table 5a)

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

(71)m=	-88.07	-88.07	-88.07	-88.07	-88.07	-88.07	-88.07	-88.07	-88.07	-88.07	-88.07	-88.07	(71)
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Water heating gains (Table 5)

(72)m=	113.15	111.16	107.01	101.37	97.71	92.55	88.17	93.78	95.78	101.62	108.21	111.17	(72)
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**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	382.45	380.53	368.48	349.07	329.47	310.46	298.04	303.58	313.48	333.08	355.62	372.42	(73)
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### 6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub>s</sub> Table 6b	FF Table 6c	Gains (W)												
North	0.9x <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.77</td></tr></table>	0.77	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">2.18</td></tr></table>	2.18	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">10.63</td></tr></table>	10.63	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.63</td></tr></table>	0.63	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.7</td></tr></table>	0.7	=	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">7.08</td></tr></table>	7.08	(74)
0.77																		
2.18																		
10.63																		
0.63																		
0.7																		
7.08																		
North	0.9x <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.77</td></tr></table>	0.77	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">3.5</td></tr></table>	3.5	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">10.63</td></tr></table>	10.63	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.63</td></tr></table>	0.63	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.7</td></tr></table>	0.7	=	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">11.37</td></tr></table>	11.37	(74)
0.77																		
3.5																		
10.63																		
0.63																		
0.7																		
11.37																		
North	0.9x <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.77</td></tr></table>	0.77	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">1.68</td></tr></table>	1.68	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">10.63</td></tr></table>	10.63	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.63</td></tr></table>	0.63	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.7</td></tr></table>	0.7	=	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">5.46</td></tr></table>	5.46	(74)
0.77																		
1.68																		
10.63																		
0.63																		
0.7																		
5.46																		
North	0.9x <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.77</td></tr></table>	0.77	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">2.18</td></tr></table>	2.18	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">20.32</td></tr></table>	20.32	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.63</td></tr></table>	0.63	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.7</td></tr></table>	0.7	=	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">13.54</td></tr></table>	13.54	(74)
0.77																		
2.18																		
20.32																		
0.63																		
0.7																		
13.54																		
North	0.9x <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.77</td></tr></table>	0.77	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">3.5</td></tr></table>	3.5	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">20.32</td></tr></table>	20.32	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.63</td></tr></table>	0.63	x	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">0.7</td></tr></table>	0.7	=	<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td style="width: 20px; height: 20px;">21.74</td></tr></table>	21.74	(74)
0.77																		
3.5																		
20.32																		
0.63																		
0.7																		
21.74																		

## TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.68	x	20.32	x	0.63	x	0.7	=	10.43	(74)
North	0.9x	0.77	x	2.18	x	34.53	x	0.63	x	0.7	=	23.01	(74)
North	0.9x	0.77	x	3.5	x	34.53	x	0.63	x	0.7	=	36.94	(74)
North	0.9x	0.77	x	1.68	x	34.53	x	0.63	x	0.7	=	17.73	(74)
North	0.9x	0.77	x	2.18	x	55.46	x	0.63	x	0.7	=	36.95	(74)
North	0.9x	0.77	x	3.5	x	55.46	x	0.63	x	0.7	=	59.33	(74)
North	0.9x	0.77	x	1.68	x	55.46	x	0.63	x	0.7	=	28.48	(74)
North	0.9x	0.77	x	2.18	x	74.72	x	0.63	x	0.7	=	49.78	(74)
North	0.9x	0.77	x	3.5	x	74.72	x	0.63	x	0.7	=	79.92	(74)
North	0.9x	0.77	x	1.68	x	74.72	x	0.63	x	0.7	=	38.36	(74)
North	0.9x	0.77	x	2.18	x	79.99	x	0.63	x	0.7	=	53.29	(74)
North	0.9x	0.77	x	3.5	x	79.99	x	0.63	x	0.7	=	85.56	(74)
North	0.9x	0.77	x	1.68	x	79.99	x	0.63	x	0.7	=	41.07	(74)
North	0.9x	0.77	x	2.18	x	74.68	x	0.63	x	0.7	=	49.75	(74)
North	0.9x	0.77	x	3.5	x	74.68	x	0.63	x	0.7	=	79.88	(74)
North	0.9x	0.77	x	1.68	x	74.68	x	0.63	x	0.7	=	38.34	(74)
North	0.9x	0.77	x	2.18	x	59.25	x	0.63	x	0.7	=	39.47	(74)
North	0.9x	0.77	x	3.5	x	59.25	x	0.63	x	0.7	=	63.37	(74)
North	0.9x	0.77	x	1.68	x	59.25	x	0.63	x	0.7	=	30.42	(74)
North	0.9x	0.77	x	2.18	x	41.52	x	0.63	x	0.7	=	27.66	(74)
North	0.9x	0.77	x	3.5	x	41.52	x	0.63	x	0.7	=	44.41	(74)
North	0.9x	0.77	x	1.68	x	41.52	x	0.63	x	0.7	=	21.32	(74)
North	0.9x	0.77	x	2.18	x	24.19	x	0.63	x	0.7	=	16.12	(74)
North	0.9x	0.77	x	3.5	x	24.19	x	0.63	x	0.7	=	25.87	(74)
North	0.9x	0.77	x	1.68	x	24.19	x	0.63	x	0.7	=	12.42	(74)
North	0.9x	0.77	x	2.18	x	13.12	x	0.63	x	0.7	=	8.74	(74)
North	0.9x	0.77	x	3.5	x	13.12	x	0.63	x	0.7	=	14.03	(74)
North	0.9x	0.77	x	1.68	x	13.12	x	0.63	x	0.7	=	6.73	(74)
North	0.9x	0.77	x	2.18	x	8.86	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	3.5	x	8.86	x	0.63	x	0.7	=	9.48	(74)
North	0.9x	0.77	x	1.68	x	8.86	x	0.63	x	0.7	=	4.55	(74)
West	0.9x	0.77	x	4.84	x	19.64	x	0.63	x	0.7	=	29.05	(80)
West	0.9x	0.77	x	4.84	x	19.64	x	0.63	x	0.7	=	29.05	(80)
West	0.9x	0.77	x	4.84	x	38.42	x	0.63	x	0.7	=	56.83	(80)
West	0.9x	0.77	x	4.84	x	38.42	x	0.63	x	0.7	=	56.83	(80)
West	0.9x	0.77	x	4.84	x	63.27	x	0.63	x	0.7	=	93.59	(80)
West	0.9x	0.77	x	4.84	x	63.27	x	0.63	x	0.7	=	93.59	(80)
West	0.9x	0.77	x	4.84	x	92.28	x	0.63	x	0.7	=	136.5	(80)
West	0.9x	0.77	x	4.84	x	92.28	x	0.63	x	0.7	=	136.5	(80)
West	0.9x	0.77	x	4.84	x	113.09	x	0.63	x	0.7	=	167.28	(80)
West	0.9x	0.77	x	4.84	x	113.09	x	0.63	x	0.7	=	167.28	(80)

## TER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	4.84	x	115.77	x	0.63	x	0.7	=	171.24	(80)
West	0.9x	0.77	x	4.84	x	115.77	x	0.63	x	0.7	=	171.24	(80)
West	0.9x	0.77	x	4.84	x	110.22	x	0.63	x	0.7	=	163.03	(80)
West	0.9x	0.77	x	4.84	x	110.22	x	0.63	x	0.7	=	163.03	(80)
West	0.9x	0.77	x	4.84	x	94.68	x	0.63	x	0.7	=	140.04	(80)
West	0.9x	0.77	x	4.84	x	94.68	x	0.63	x	0.7	=	140.04	(80)
West	0.9x	0.77	x	4.84	x	73.59	x	0.63	x	0.7	=	108.85	(80)
West	0.9x	0.77	x	4.84	x	73.59	x	0.63	x	0.7	=	108.85	(80)
West	0.9x	0.77	x	4.84	x	45.59	x	0.63	x	0.7	=	67.43	(80)
West	0.9x	0.77	x	4.84	x	45.59	x	0.63	x	0.7	=	67.43	(80)
West	0.9x	0.77	x	4.84	x	24.49	x	0.63	x	0.7	=	36.22	(80)
West	0.9x	0.77	x	4.84	x	24.49	x	0.63	x	0.7	=	36.22	(80)
West	0.9x	0.77	x	4.84	x	16.15	x	0.63	x	0.7	=	23.89	(80)
West	0.9x	0.77	x	4.84	x	16.15	x	0.63	x	0.7	=	23.89	(80)

Solar gains in watts, calculated for each month

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

(83)m=	82.02	159.37	264.85	397.75	502.62	522.4	494.03	413.35	311.09	189.28	101.95	67.72	(83)
--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	464.47	539.9	633.33	746.82	832.09	832.86	792.08	716.92	624.56	522.36	457.57	440.14	(84)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

### 7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.91	0.76	0.56	0.41	0.47	0.75	0.96	0.99	1	(86)

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

(87)m=	19.88	20.04	20.33	20.68	20.91	20.98	21	20.99	20.93	20.61	20.18	19.85	(87)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	------

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

(88)m=	19.99	19.99	19.99	20	20	20.01	20.01	20.01	20.01	20	20	19.99	(88)
--------	-------	-------	-------	----	----	-------	-------	-------	-------	----	----	-------	------

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

(89)m=	1	0.99	0.97	0.88	0.7	0.48	0.32	0.37	0.67	0.94	0.99	1	(89)
--------	---	------	------	------	-----	------	------	------	------	------	------	---	------

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

(90)m=	18.49	18.74	19.15	19.64	19.92	20	20.01	20.01	19.96	19.56	18.94	18.46	(90)
--------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.37 (91)

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

(92)m=	19	19.22	19.58	20.02	20.28	20.36	20.37	20.37	20.32	19.95	19.4	18.97	(92)
--------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

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

(93)m=	19	19.22	19.58	20.02	20.28	20.36	20.37	20.37	20.32	19.95	19.4	18.97	(93)
--------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

### 8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	0.99	0.99	0.96	0.88	0.72	0.51	0.35	0.41	0.69	0.93	0.99	1	(94)

# TER WorkSheet: New dwelling design stage

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

(95)m=	461.53	532.48	609.35	658.79	595.67	421.78	279.56	293.01	433.93	488.1	451.54	437.98	(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=	1122.19	1090.4	994.12	836.1	643.69	428.21	280.34	294.64	463.72	701.14	926.2	1117.1	(97)
--------	---------	--------	--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	------

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

(98)m=	491.53	374.92	286.26	127.67	35.73	0	0	0	0	158.5	341.76	505.27	
--------	--------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------	--

Total per year (kWh/year) = Sum(98)<sub>1...5,9...12</sub> = 2321.63 (98)

Space heating requirement in kWh/m<sup>2</sup>/year

													(99)
	<span style="border: 1px solid black; padding: 2px;">34.04</span>												

**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 93.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

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

Space heating requirement (calculated above)

491.53	374.92	286.26	127.67	35.73	0	0	0	0	158.5	341.76	505.27
--------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------

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

525.71	400.98	306.16	136.54	38.21	0	0	0	0	169.51	365.51	540.39
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Total (kWh/year) =Sum(211)<sub>1...5,10...12</sub> = 2483.03 (211)

Space heating fuel (secondary), kWh/month

= {[ (98)m x (201)] } x 100 ÷ (208)

(215)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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(215)

Total (kWh/year) =Sum(215)<sub>1...5,10...12</sub> = 0 (215)

**Water heating**

Output from water heater (calculated above)

187.68	165.48	173.93	156.1	153.11	137.01	131.77	144.33	144	161.86	170.91	183.23
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Efficiency of water heater 79.8 (216)

(217)m= 

87.27	86.93	86.13	84.28	81.63	79.8	79.8	79.8	79.8	84.76	86.63	87.38
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(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m= 

215.07	190.36	201.92	185.21	187.58	171.69	165.13	180.87	180.45	190.97	197.3	209.69
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------

Total = Sum(219a)<sub>1...12</sub> = 2276.24 (219)

**Annual totals**

Space heating fuel used, main system 1 2483.03 kWh/year

Water heating fuel used 2276.24 kWh/year

Electricity for pumps, fans and electric keep-hot

central heating pump: 30 kWh/year (230c)

## TER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
Electricity for lighting		303.96	(232)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x		0.216	=	536.33 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)
Water heating	(219) x		0.216	=	491.67 (264)
Space and water heating	(261) + (262) + (263) + (264) =				1028 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93 (267)
Electricity for lighting	(232) x		0.519	=	157.75 (268)
Total CO2, kg/year		sum of (265)...(271) =			1224.68 (272)
<b>TER =</b>					17.96 (273)



## DER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

### Property Address: GT 102 - Be Lean

**Address :** GT 102, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	51.3	(1a) x	2.6	(2a) =	133.38 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.3	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	133.38 (5)

### 2. Ventilation rate:

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

**Air changes per hour**

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 0 ÷ (5) = 0 (8)

*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 0 [(9)-1]x0.1 = (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  $0.25 - [0.2 \times (14) \div 100] =$  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 2 (17)

If based on air permeability value, then  $(18) = [(17) \div 20] + (8)$ , otherwise  $(18) = (16)$  0.1 (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  $(20) = 1 - [0.075 \times (19)] =$  0.78 (20)

Infiltration rate incorporating shelter factor  $(21) = (18) \times (20) =$  0.08 (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
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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# DER WorkSheet: New dwelling design stage

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

0.1	0.1	0.09	0.09	0.08	0.07	0.07	0.07	0.08	0.08	0.09	0.09
-----	-----	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 

0.22	0.21	0.21	0.2	0.2	0.19	0.19	0.19	0.2	0.2	0.2	0.21
------	------	------	-----	-----	------	------	------	-----	-----	-----	------

 (24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24d)

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

(25)m= 

0.22	0.21	0.21	0.2	0.2	0.19	0.19	0.19	0.2	0.2	0.2	0.21
------	------	------	-----	-----	------	------	------	-----	-----	-----	------

 (25)

**3. Heat losses and heat loss parameter:**

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			1.5	x1/[1/(1.4)+0.04] =	1.99		(27)
Windows Type 2			9.25	x1/[1/(1.4)+0.04] =	12.26		(27)
Floor			51.3	x 0.1 =	5.13		(28)
Walls	23.92	10.75	13.17	x 0.12 =	1.58		(29)
Total area of elements, m <sup>2</sup>			75.22				(31)
Party wall			49.92	x 0 =	0		(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 20.96 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 4.13 (36)

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

Total fabric heat loss (33) + (36) = 25.1 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	9.52	9.44	9.35	8.92	8.84	8.41	8.41	8.33	8.58	8.84	9.01	9.18

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

(39)m=	34.62	34.53	34.45	34.02	33.94	33.51	33.51	33.42	33.68	33.94	34.11	34.28
Average = Sum(39) <sub>1...12</sub> /12=												34 (39)

## DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m<sup>2</sup>K

(40)m = (39)m ÷ (4)

(40)m=	0.67	0.67	0.67	0.66	0.66	0.65	0.65	0.65	0.66	0.66	0.66	0.67	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.66	(40)

Number of days in month (Table 1a)

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

### 4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N 1.73 (42)

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

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day V<sub>d,average</sub> = (25 x N) + 36 75.25 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month V <sub>d,m</sub> = factor from Table 1c x (43)													
(44)m=	82.77	79.76	76.75	73.74	70.73	67.72	67.72	70.73	73.74	76.75	79.76	82.77	(44)
Total = Sum(44) <sub>1...12</sub> =												903	

Energy content of hot water used - calculated monthly = 4.190 x V<sub>d,m</sub> x nm x DT<sub>m</sub> / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	122.75	107.36	110.79	96.59	92.68	79.97	74.11	85.04	86.05	100.29	109.47	118.88	(45)
Total = Sum(45) <sub>1...12</sub> =												1183.97	

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

(46)m= 18.41 16.1 16.62 14.49 13.9 12 11.12 12.76 12.91 15.04 16.42 17.83 (46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m= 32.01 28.92 32.01 30.98 32.01 30.98 32.01 32.01 30.98 32.01 30.98 32.01 (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= 32.01 28.92 32.01 30.98 32.01 30.98 32.01 32.01 30.98 32.01 30.98 32.01 (57)

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

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

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

(59)m= 23.26 21.01 23.26 22.51 23.26 22.51 23.26 23.26 22.51 23.26 22.51 23.26 (59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	178.03	157.29	166.06	150.08	147.95	133.47	129.38	140.32	139.55	155.56	162.97	174.16	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	178.03	157.29	166.06	150.08	147.95	133.47	129.38	140.32	139.55	155.56	162.97	174.16	
Output from water heater (annual) <sub>1...12</sub>												(64)	
												1834.81	

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

(65)m=	85.04	75.64	81.06	74.91	75.04	69.39	68.86	72.5	71.41	77.57	79.19	83.75	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	86.42	86.42	86.42	86.42	86.42	86.42	86.42	86.42	86.42	86.42	86.42	86.42	(66)

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

(67)m=	13.43	11.93	9.7	7.34	5.49	4.63	5.01	6.51	8.74	11.09	12.95	13.8	(67)
--------	-------	-------	-----	------	------	------	------	------	------	-------	-------	------	------

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

(68)m=	150.61	152.17	148.23	139.85	129.27	119.32	112.67	111.11	115.05	123.43	134.02	143.96	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64	(69)
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Pumps and fans gains (Table 5a)

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

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

(71)m=	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	(71)
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Water heating gains (Table 5)

(72)m=	114.3	112.56	108.95	104.04	100.86	96.37	92.56	97.44	99.18	104.26	109.99	112.57	(72)
--------	-------	--------	--------	--------	--------	-------	-------	-------	-------	--------	--------	--------	------

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

(73)m=	327.26	325.58	315.81	300.16	284.54	269.25	259.16	263.99	271.89	287.71	305.88	319.26	(73)
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### 6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m <sup>2</sup>		Flux Table 6a		g <sub>g</sub> Table 6b		FF Table 6c		Gains (W)		
West	0.9x	0.77	x	1.5	x	19.64	x	0.4	x	0.8	=	6.53	(80)
West	0.9x	0.77	x	9.25	x	19.64	x	0.4	x	0.8	=	40.29	(80)
West	0.9x	0.77	x	1.5	x	38.42	x	0.4	x	0.8	=	12.78	(80)
West	0.9x	0.77	x	9.25	x	38.42	x	0.4	x	0.8	=	78.81	(80)
West	0.9x	0.77	x	1.5	x	63.27	x	0.4	x	0.8	=	21.05	(80)

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West	0.9x	0.77	x	9.25	x	63.27	x	0.4	x	0.8	=	129.79	(80)
West	0.9x	0.77	x	1.5	x	92.28	x	0.4	x	0.8	=	30.7	(80)
West	0.9x	0.77	x	9.25	x	92.28	x	0.4	x	0.8	=	189.29	(80)
West	0.9x	0.77	x	1.5	x	113.09	x	0.4	x	0.8	=	37.62	(80)
West	0.9x	0.77	x	9.25	x	113.09	x	0.4	x	0.8	=	231.98	(80)
West	0.9x	0.77	x	1.5	x	115.77	x	0.4	x	0.8	=	38.51	(80)
West	0.9x	0.77	x	9.25	x	115.77	x	0.4	x	0.8	=	237.48	(80)
West	0.9x	0.77	x	1.5	x	110.22	x	0.4	x	0.8	=	36.66	(80)
West	0.9x	0.77	x	9.25	x	110.22	x	0.4	x	0.8	=	226.09	(80)
West	0.9x	0.77	x	1.5	x	94.68	x	0.4	x	0.8	=	31.49	(80)
West	0.9x	0.77	x	9.25	x	94.68	x	0.4	x	0.8	=	194.21	(80)
West	0.9x	0.77	x	1.5	x	73.59	x	0.4	x	0.8	=	24.48	(80)
West	0.9x	0.77	x	9.25	x	73.59	x	0.4	x	0.8	=	150.95	(80)
West	0.9x	0.77	x	1.5	x	45.59	x	0.4	x	0.8	=	15.16	(80)
West	0.9x	0.77	x	9.25	x	45.59	x	0.4	x	0.8	=	93.52	(80)
West	0.9x	0.77	x	1.5	x	24.49	x	0.4	x	0.8	=	8.15	(80)
West	0.9x	0.77	x	9.25	x	24.49	x	0.4	x	0.8	=	50.23	(80)
West	0.9x	0.77	x	1.5	x	16.15	x	0.4	x	0.8	=	5.37	(80)
West	0.9x	0.77	x	9.25	x	16.15	x	0.4	x	0.8	=	33.13	(80)

Solar gains in watts, calculated for each month

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

(83)m=	46.82	91.59	150.84	219.99	269.6	275.99	262.75	225.7	175.43	108.68	58.38	38.5	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	374.08	417.17	466.65	520.15	554.14	545.24	521.91	489.69	447.32	396.39	364.26	357.76	(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	0.97	0.92	0.76	0.57	0.39	0.28	0.31	0.52	0.83	0.97	0.99	(86)

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

(87)m=	20.58	20.7	20.85	20.97	21	21	21	21	21	20.95	20.76	20.56	(87)
--------	-------	------	-------	-------	----	----	----	----	----	-------	-------	-------	------

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

(88)m=	20.36	20.36	20.37	20.37	20.37	20.38	20.38	20.38	20.38	20.37	20.37	20.37	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.96	0.9	0.73	0.53	0.36	0.24	0.27	0.47	0.8	0.96	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.81	19.98	20.19	20.34	20.37	20.38	20.38	20.38	20.38	20.33	20.07	19.78	(90)
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fLA = Living area ÷ (4) = 0.5 (91)

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

(92)m=	20.2	20.34	20.52	20.65	20.68	20.69	20.69	20.69	20.69	20.64	20.41	20.17	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	20.2	20.34	20.52	20.65	20.68	20.69	20.69	20.69	20.69	20.64	20.41	20.17	(93)
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### 8. Space heating requirement

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

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

(94)m=	0.98	0.96	0.9	0.74	0.55	0.37	0.26	0.29	0.5	0.81	0.96	0.99	(94)
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Useful gains,  $h_m G_m$ ,  $W = (94)m \times (84)m$

(95)m=	368.12	402.34	421.04	387.37	303.68	204	137.03	143.39	221.45	321.5	349.78	353.4	(95)
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Monthly average external temperature from Table 8

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

Heat loss rate for mean internal temperature,  $L_m$ ,  $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	550.26	533.05	483.03	399.89	304.84	204.05	137.03	143.39	221.85	340.65	453.98	547.25	(97)
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Space heating requirement for each month,  $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	135.51	87.84	46.12	9.01	0.86	0	0	0	0	14.25	75.02	144.22	
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Total per year (kWh/year) =  $Sum(98)_{1..12} =$  512.84 (98)

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

	10	(99)
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### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

Fraction of heat from Community boilers 1 (303a)

Fraction of total space heat from Community boilers (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.1 (306)

#### Space heating

Annual space heating requirement 512.84

Space heat from Community boilers (98) x (304a) x (305) x (306) = 564.12 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0 (308)

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = 0 (309)

#### Water heating

Annual water heating requirement 1834.81

If DHW from community scheme:  
Water heat from Community boilers (64) x (303a) x (305) x (306) = 2018.3 (310a)

Electricity used for heat distribution 0.01 x [(307a)...(307e) + (310a)...(310e)] = 25.82 (313)

Cooling System Energy Efficiency Ratio 0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0) = (107) ÷ (314) = 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):  
mechanical ventilation - balanced, extract or positive input from outside 101.7 (330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	101.7	(331)
Energy for lighting (calculated in Appendix L)		237.12	(332)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)		If there is CHP using two fuels repeat (363) to (366) for the second fuel			95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	587.16	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	13.4	(372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)			=	600.56	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				600.56	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331) x		0.52	=	52.78	(378)
CO2 associated with electricity for lighting	(332)) x		0.52	=	123.07	(379)
<b>Total CO2, kg/year</b>	sum of (376)...(382) =				776.41	(383)
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =				15.13	(384)
<b>EI rating (section 14)</b>					89.2	(385)

## TER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

### Property Address: GT 102 - Be Lean

**Address :** GT 102, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	51.3	(1a) x	2.6	(2a) =	133.38 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.3	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	133.38 (5)

### 2. Ventilation rate:

	main heating		secondary heating		other		total		m <sup>3</sup> 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) =	0.15 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.4 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.31 (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

<b>(22)m=</b>	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

<b>(22a)m=</b>	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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# TER WorkSheet: New dwelling design stage

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

0.4	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36
-----	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:  (23a)

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

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

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

(24a)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
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(24d)

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

(25)m= 

0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
------	------	------	------	------	------	------	------	------	------	------	------

(25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			<input type="text" value="1.5"/>	$\times 1/[1/(1.4)+0.04] =$	<input type="text" value="1.99"/>		(27)
Windows Type 2			<input type="text" value="9.25"/>	$\times 1/[1/(1.4)+0.04] =$	<input type="text" value="12.26"/>		(27)
Floor			<input type="text" value="51.3"/>	$\times$ <input type="text" value="0.13"/>	$=$ <input type="text" value="6.669"/>	<input type="text"/>	(28)
Walls	<input type="text" value="23.92"/>	<input type="text" value="10.75"/>	<input type="text" value="13.17"/>	$\times$ <input type="text" value="0.18"/>	$=$ <input type="text" value="2.37"/>	<input type="text"/>	(29)
Total area of elements, m <sup>2</sup>			<input type="text" value="75.22"/>				(31)
Party wall			<input type="text" value="49.92"/>	$\times$ <input type="text" value="0"/>	$=$ <input type="text" value="0"/>	<input type="text"/>	(32)

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

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

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

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium  (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  (36)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	25.44	25.31	25.18	24.57	24.45	23.92	23.92	23.82	24.12	24.45	24.68	24.93

(38)

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

(39)m=	51.45	51.31	51.18	50.57	50.45	49.92	49.92	49.82	50.12	50.45	50.69	50.93
	Average = Sum(39) <sub>1...12</sub> /12=											
	<input type="text" value="50.57"/> (39)											

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Heat loss parameter (HLP), W/m<sup>2</sup>K

(40)m = (39)m ÷ (4)

(40)m=	1	1	1	0.99	0.98	0.97	0.97	0.97	0.98	0.98	0.99	0.99	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.99	(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 1.73 (42)  
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)<sup>2</sup>)] + 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 75.25 (43)  
 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	82.77	79.76	76.75	73.74	70.73	67.72	67.72	70.73	73.74	76.75	79.76	82.77	(44)
Total = Sum(44) <sub>1...12</sub> =												903	

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	122.75	107.36	110.79	96.59	92.68	79.97	74.11	85.04	86.05	100.29	109.47	118.88	(45)
Total = Sum(45) <sub>1...12</sub> =												1183.97	

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

(46)m= 

18.41	16.1	16.62	14.49	13.9	12	11.12	12.76	12.91	15.04	16.42	17.83
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 (46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (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) 0.75 (55)

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

(56)m= 

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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= 

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (57)

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

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

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

(59)m= 

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
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 (59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	169.35	149.45	157.38	141.68	139.27	125.06	120.7	131.63	131.15	146.88	154.56	165.47	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHS and/or WWHS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	169.35	149.45	157.38	141.68	139.27	125.06	120.7	131.63	131.15	146.88	154.56	165.47	
<b>Output from water heater (annual)<sup>1...12</sup></b>												(64)	
											1732.59		

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

(65)m=	78.09	69.37	74.11	68.19	68.09	62.66	61.92	65.55	64.69	70.62	72.47	76.8	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	86.42	86.42	86.42	86.42	86.42	86.42	86.42	86.42	86.42	86.42	86.42	86.42	(66)

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

(67)m=	13.47	11.96	9.73	7.36	5.5	4.65	5.02	6.53	8.76	11.12	12.98	13.84	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	150.61	152.17	148.23	139.85	129.27	119.32	112.67	111.11	115.05	123.43	134.02	143.96	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

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

(71)m=	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	(71)
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Water heating gains (Table 5)

(72)m=	104.96	103.22	99.61	94.71	91.52	87.03	83.22	88.11	89.84	94.92	100.66	103.23	(72)
--------	--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	--------	--------	------

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

(73)m=	320.96	319.28	309.5	293.85	278.22	262.93	252.84	257.67	265.58	281.4	299.58	312.96	(73)
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## 6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m <sup>2</sup>		Flux Table 6a		g <sub>g</sub> Table 6b		FF Table 6c		Gains (W)
West	0.9x	0.77	x	1.5	x	19.64	x	0.63	x	0.7	= <span style="border: 1px solid black; text-align: center;">9</span> (80)
West	0.9x	0.77	x	9.25	x	19.64	x	0.63	x	0.7	= <span style="border: 1px solid black; text-align: center;">55.52</span> (80)
West	0.9x	0.77	x	1.5	x	38.42	x	0.63	x	0.7	= <span style="border: 1px solid black; text-align: center;">17.61</span> (80)
West	0.9x	0.77	x	9.25	x	38.42	x	0.63	x	0.7	= <span style="border: 1px solid black; text-align: center;">108.61</span> (80)
West	0.9x	0.77	x	1.5	x	63.27	x	0.63	x	0.7	= <span style="border: 1px solid black; text-align: center;">29.01</span> (80)

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West	0.9x	0.77	x	9.25	x	63.27	x	0.63	x	0.7	=	178.87	(80)
West	0.9x	0.77	x	1.5	x	92.28	x	0.63	x	0.7	=	42.3	(80)
West	0.9x	0.77	x	9.25	x	92.28	x	0.63	x	0.7	=	260.87	(80)
West	0.9x	0.77	x	1.5	x	113.09	x	0.63	x	0.7	=	51.84	(80)
West	0.9x	0.77	x	9.25	x	113.09	x	0.63	x	0.7	=	319.7	(80)
West	0.9x	0.77	x	1.5	x	115.77	x	0.63	x	0.7	=	53.07	(80)
West	0.9x	0.77	x	9.25	x	115.77	x	0.63	x	0.7	=	327.27	(80)
West	0.9x	0.77	x	1.5	x	110.22	x	0.63	x	0.7	=	50.53	(80)
West	0.9x	0.77	x	9.25	x	110.22	x	0.63	x	0.7	=	311.58	(80)
West	0.9x	0.77	x	1.5	x	94.68	x	0.63	x	0.7	=	43.4	(80)
West	0.9x	0.77	x	9.25	x	94.68	x	0.63	x	0.7	=	267.64	(80)
West	0.9x	0.77	x	1.5	x	73.59	x	0.63	x	0.7	=	33.73	(80)
West	0.9x	0.77	x	9.25	x	73.59	x	0.63	x	0.7	=	208.03	(80)
West	0.9x	0.77	x	1.5	x	45.59	x	0.63	x	0.7	=	20.9	(80)
West	0.9x	0.77	x	9.25	x	45.59	x	0.63	x	0.7	=	128.88	(80)
West	0.9x	0.77	x	1.5	x	24.49	x	0.63	x	0.7	=	11.23	(80)
West	0.9x	0.77	x	9.25	x	24.49	x	0.63	x	0.7	=	69.23	(80)
West	0.9x	0.77	x	1.5	x	16.15	x	0.63	x	0.7	=	7.4	(80)
West	0.9x	0.77	x	9.25	x	16.15	x	0.63	x	0.7	=	45.66	(80)

Solar gains in watts, calculated for each month

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

(83)m=	64.52	126.22	207.87	303.17	371.55	380.35	362.1	311.04	241.77	149.78	80.46	53.06	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	385.49	445.51	517.37	597.02	649.77	643.27	614.95	568.71	507.34	431.18	380.04	366.02	(84)
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### 7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.96	0.86	0.69	0.49	0.36	0.4	0.66	0.92	0.99	1	(86)

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

(87)m=	20.1	20.27	20.53	20.82	20.96	20.99	21	21	20.98	20.76	20.38	20.07	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.08	20.08	20.09	20.1	20.1	20.11	20.11	20.11	20.1	20.1	20.09	20.09	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.94	0.83	0.63	0.43	0.28	0.32	0.58	0.89	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.9	19.14	19.51	19.9	20.06	20.1	20.11	20.11	20.09	19.84	19.3	18.86	(90)
--------	------	-------	-------	------	-------	------	-------	-------	-------	-------	------	-------	------

fLA = Living area ÷ (4) = 0.5 (91)

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

(92)m=	19.5	19.7	20.02	20.35	20.51	20.55	20.55	20.55	20.53	20.29	19.84	19.46	(92)
--------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

## TER WorkSheet: New dwelling design stage

(93)m=	19.5	19.7	20.02	20.35	20.51	20.55	20.55	20.55	20.53	20.29	19.84	19.46	(93)
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### 8. Space heating requirement

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

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

Utilisation factor for gains,  $h_m$ :

(94)m=	0.99	0.98	0.94	0.84	0.66	0.46	0.32	0.36	0.62	0.9	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	-----	------	------	------

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

(95)m=	381.77	436.09	487.77	499.97	426.86	294.94	196.98	206.37	313.06	387.6	372.13	363.29	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature,  $L_m$ ,  $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	781.87	759.58	692.06	579.14	444.27	296.81	197.17	206.76	322.17	489.12	645.62	777.35	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	297.67	217.38	151.99	57.01	12.95	0	0	0	0	75.53	196.92	308.06	
<b>Total per year (kWh/year) = Sum(98)<sub>1...5,9...12</sub> =</b>												1317.51	(98)

Space heating requirement in  $kWh/m^2/year$  25.68 (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 93.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

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

Space heating requirement (calculated above)

297.67	217.38	151.99	57.01	12.95	0	0	0	0	75.53	196.92	308.06
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------

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

(211)m=	318.37	232.5	162.56	60.97	13.85	0	0	0	0	80.78	210.6	329.48	
<b>Total (kWh/year) = Sum(211)<sub>1...5,10...12</sub> =</b>												1409.1	(211)

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

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

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	
<b>Total (kWh/year) = Sum(215)<sub>1...5,10...12</sub> =</b>												0	(215)

#### Water heating

Output from water heater (calculated above)

169.35	149.45	157.38	141.68	139.27	125.06	120.7	131.63	131.15	146.88	154.56	165.47
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Efficiency of water heater 79.8 (216)

(217)m= (217)

86.3	85.81	84.72	82.6	80.61	79.8	79.8	79.8	79.8	83.14	85.46	86.45
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Fuel for water heating,  $kWh/month$

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

(219)m=	196.22	174.15	185.76	171.52	172.77	156.72	151.26	164.95	164.34	176.67	180.86	191.41	
<b>Total = Sum(219a)<sub>1...12</sub> =</b>												2086.65	(219)

#### Annual totals

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

														1409.1	
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## TER WorkSheet: New dwelling design stage

Water heating fuel used		2086.65	
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		237.81	(232)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x		0.216	=	304.37 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)
Water heating	(219) x		0.216	=	450.72 (264)
Space and water heating	(261) + (262) + (263) + (264) =				755.08 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93 (267)
Electricity for lighting	(232) x		0.519	=	123.42 (268)
Total CO2, kg/year		sum of (265)...(271) =			917.43 (272)
 <b>TER =</b>					 17.88 (273)

## DER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

### Property Address: GT 103 - Be Lean

**Address :** GT 103, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	<b>Area(m<sup>2</sup>)</b>		<b>Av. Height(m)</b>		<b>Volume(m<sup>3</sup>)</b>
Ground floor	74.8	(1a) x	2.6	(2a) =	194.48
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.8	(4)			
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =				194.48

### 2. Ventilation rate:

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

### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			2	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.1	(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>				
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.09	(21)

Infiltration rate modified for monthly wind speed

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

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

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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## DER WorkSheet: New dwelling design stage

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

0.12	0.12	0.11	0.1	0.1	0.09	0.09	0.09	0.09	0.1	0.1	0.11
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 

0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.2	0.21	0.22	0.22	0.23
------	------	------	------	------	------	------	-----	------	------	------	------

 (24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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 (24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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 (24d)

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

(25)m= 

0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.2	0.21	0.22	0.22	0.23
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 (25)

**3. Heat losses and heat loss parameter:**

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			4.01	x1/[1/(1.4)+0.04] =	5.32		(27)
Windows Type 2			3.95	x1/[1/(1.4)+0.04] =	5.24		(27)
Windows Type 3			2.24	x1/[1/(1.4)+0.04] =	2.97		(27)
Windows Type 4			2.24	x1/[1/(1.4)+0.04] =	2.97		(27)
Windows Type 5			4.01	x1/[1/(1.4)+0.04] =	5.32		(27)
Windows Type 6			4.01	x1/[1/(1.4)+0.04] =	5.32		(27)
Windows Type 7			1.5	x1/[1/(1.4)+0.04] =	1.99		(27)
Floor			74.8	x 0.1 =	7.48		(28)
Walls	61.39	21.96	39.43	x 0.12 =	4.73		(29)
Total area of elements, m <sup>2</sup>			136.19				(31)
Party wall			52.57	x 0 =	0		(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 41.32 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 10.08 (36)

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

Total fabric heat loss (33) + (36) = 51.4 (37)



## DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	15.11	14.96	14.81	14.07	13.92	13.18	13.18	13.03	13.48	13.92	14.22	14.52	(38)

Heat transfer coefficient, W/K

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

(39)m=	66.51	66.36	66.21	65.47	65.32	64.58	64.58	64.43	64.88	65.32	65.62	65.92	
Average = Sum(39) <sub>1...12</sub> / 12 =												65.43	(39)

Heat loss parameter (HLP), W/m<sup>2</sup>K

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

(40)m=	0.89	0.89	0.89	0.88	0.87	0.86	0.86	0.86	0.87	0.87	0.88	0.88	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.87	(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

2.36

(42)

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

if TFA ≤ 13.9, N = 1

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

90.17

(43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	99.19	95.58	91.98	88.37	84.76	81.16	81.16	84.76	88.37	91.98	95.58	99.19	
Total = Sum(44) <sub>1...12</sub> =												1082.09	(44)

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

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=	147.1	128.65	132.76	115.74	111.06	95.83	88.8	101.9	103.12	120.18	131.18	142.46	
Total = Sum(45) <sub>1...12</sub> =												1418.79	(45)

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

(46)m=	22.06	19.3	19.91	17.36	16.66	14.38	13.32	15.29	15.47	18.03	19.68	21.37	(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

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

110

(50)

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

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

0.02

(51)

If community heating see section 4.3

Volume factor from Table 2a

1.03

(52)

Temperature factor from Table 2b

0.6

(53)

Energy lost from water storage, kWh/year

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

1.03

(54)

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

1.03

(55)

Water storage loss calculated for each month

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
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# DER WorkSheet: New dwelling design stage

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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)
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Primary circuit loss (annual) from Table 3	0	(58)
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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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	202.38	178.58	188.04	169.24	166.33	149.33	144.08	157.18	156.61	175.45	184.68	197.73	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	202.38	178.58	188.04	169.24	166.33	149.33	144.08	157.18	156.61	175.45	184.68	197.73	
Output from water heater (annual) <sub>1...12</sub>												2069.63	(64)

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

(65)m=	93.13	82.72	88.36	81.28	81.15	74.66	73.75	78.1	77.08	84.18	86.41	91.59	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	(66)

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

(67)m=	18.56	16.49	13.41	10.15	7.59	6.41	6.92	9	12.08	15.33	17.9	19.08	(67)
--------	-------	-------	-------	-------	------	------	------	---	-------	-------	------	-------	------

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

(68)m=	208.23	210.39	204.95	193.36	178.72	164.97	155.78	153.62	159.07	170.66	185.29	199.04	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

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

(71)m=	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	(71)
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Water heating gains (Table 5)

(72)m=	125.18	123.09	118.77	112.89	109.07	103.69	99.12	104.98	107.06	113.15	120.02	123.1	(72)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	------

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

(73)m=	410.32	408.33	395.48	374.75	353.73	333.42	320.18	325.95	336.55	357.49	381.56	399.58	(73)
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## 6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
--------------	---------------------------	------------------------	------------------	----------------	----------------	--------------

## DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	4.01	x	19.64	x	0.4	x	0.8	=	17.47	(76)
East	0.9x	0.77	x	4.01	x	38.42	x	0.4	x	0.8	=	34.17	(76)
East	0.9x	0.77	x	4.01	x	63.27	x	0.4	x	0.8	=	56.27	(76)
East	0.9x	0.77	x	4.01	x	92.28	x	0.4	x	0.8	=	82.06	(76)
East	0.9x	0.77	x	4.01	x	113.09	x	0.4	x	0.8	=	100.57	(76)
East	0.9x	0.77	x	4.01	x	115.77	x	0.4	x	0.8	=	102.95	(76)
East	0.9x	0.77	x	4.01	x	110.22	x	0.4	x	0.8	=	98.01	(76)
East	0.9x	0.77	x	4.01	x	94.68	x	0.4	x	0.8	=	84.19	(76)
East	0.9x	0.77	x	4.01	x	73.59	x	0.4	x	0.8	=	65.44	(76)
East	0.9x	0.77	x	4.01	x	45.59	x	0.4	x	0.8	=	40.54	(76)
East	0.9x	0.77	x	4.01	x	24.49	x	0.4	x	0.8	=	21.78	(76)
East	0.9x	0.77	x	4.01	x	16.15	x	0.4	x	0.8	=	14.36	(76)
South	0.9x	0.77	x	3.95	x	46.75	x	0.4	x	0.8	=	40.95	(78)
South	0.9x	0.77	x	2.24	x	46.75	x	0.4	x	0.8	=	23.22	(78)
South	0.9x	0.77	x	2.24	x	46.75	x	0.4	x	0.8	=	23.22	(78)
South	0.9x	0.77	x	4.01	x	46.75	x	0.4	x	0.8	=	41.57	(78)
South	0.9x	0.77	x	3.95	x	76.57	x	0.4	x	0.8	=	67.07	(78)
South	0.9x	0.77	x	2.24	x	76.57	x	0.4	x	0.8	=	38.03	(78)
South	0.9x	0.77	x	2.24	x	76.57	x	0.4	x	0.8	=	38.03	(78)
South	0.9x	0.77	x	4.01	x	76.57	x	0.4	x	0.8	=	68.09	(78)
South	0.9x	0.77	x	3.95	x	97.53	x	0.4	x	0.8	=	85.43	(78)
South	0.9x	0.77	x	2.24	x	97.53	x	0.4	x	0.8	=	48.45	(78)
South	0.9x	0.77	x	2.24	x	97.53	x	0.4	x	0.8	=	48.45	(78)
South	0.9x	0.77	x	4.01	x	97.53	x	0.4	x	0.8	=	86.73	(78)
South	0.9x	0.77	x	3.95	x	110.23	x	0.4	x	0.8	=	96.56	(78)
South	0.9x	0.77	x	2.24	x	110.23	x	0.4	x	0.8	=	54.76	(78)
South	0.9x	0.77	x	2.24	x	110.23	x	0.4	x	0.8	=	54.76	(78)
South	0.9x	0.77	x	4.01	x	110.23	x	0.4	x	0.8	=	98.03	(78)
South	0.9x	0.77	x	3.95	x	114.87	x	0.4	x	0.8	=	100.62	(78)
South	0.9x	0.77	x	2.24	x	114.87	x	0.4	x	0.8	=	57.06	(78)
South	0.9x	0.77	x	2.24	x	114.87	x	0.4	x	0.8	=	57.06	(78)
South	0.9x	0.77	x	4.01	x	114.87	x	0.4	x	0.8	=	102.15	(78)
South	0.9x	0.77	x	3.95	x	110.55	x	0.4	x	0.8	=	96.83	(78)
South	0.9x	0.77	x	2.24	x	110.55	x	0.4	x	0.8	=	54.91	(78)
South	0.9x	0.77	x	2.24	x	110.55	x	0.4	x	0.8	=	54.91	(78)
South	0.9x	0.77	x	4.01	x	110.55	x	0.4	x	0.8	=	98.31	(78)
South	0.9x	0.77	x	3.95	x	108.01	x	0.4	x	0.8	=	94.61	(78)
South	0.9x	0.77	x	2.24	x	108.01	x	0.4	x	0.8	=	53.65	(78)
South	0.9x	0.77	x	2.24	x	108.01	x	0.4	x	0.8	=	53.65	(78)
South	0.9x	0.77	x	4.01	x	108.01	x	0.4	x	0.8	=	96.05	(78)
South	0.9x	0.77	x	3.95	x	104.89	x	0.4	x	0.8	=	91.88	(78)

## DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	2.24	x	104.89	x	0.4	x	0.8	=	52.11	(78)
South	0.9x	0.77	x	2.24	x	104.89	x	0.4	x	0.8	=	52.11	(78)
South	0.9x	0.77	x	4.01	x	104.89	x	0.4	x	0.8	=	93.28	(78)
South	0.9x	0.77	x	3.95	x	101.89	x	0.4	x	0.8	=	89.25	(78)
South	0.9x	0.77	x	2.24	x	101.89	x	0.4	x	0.8	=	50.61	(78)
South	0.9x	0.77	x	2.24	x	101.89	x	0.4	x	0.8	=	50.61	(78)
South	0.9x	0.77	x	4.01	x	101.89	x	0.4	x	0.8	=	90.6	(78)
South	0.9x	0.77	x	3.95	x	82.59	x	0.4	x	0.8	=	72.34	(78)
South	0.9x	0.77	x	2.24	x	82.59	x	0.4	x	0.8	=	41.02	(78)
South	0.9x	0.77	x	2.24	x	82.59	x	0.4	x	0.8	=	41.02	(78)
South	0.9x	0.77	x	4.01	x	82.59	x	0.4	x	0.8	=	73.44	(78)
South	0.9x	0.77	x	3.95	x	55.42	x	0.4	x	0.8	=	48.54	(78)
South	0.9x	0.77	x	2.24	x	55.42	x	0.4	x	0.8	=	27.53	(78)
South	0.9x	0.77	x	2.24	x	55.42	x	0.4	x	0.8	=	27.53	(78)
South	0.9x	0.77	x	4.01	x	55.42	x	0.4	x	0.8	=	49.28	(78)
South	0.9x	0.77	x	3.95	x	40.4	x	0.4	x	0.8	=	35.39	(78)
South	0.9x	0.77	x	2.24	x	40.4	x	0.4	x	0.8	=	20.07	(78)
South	0.9x	0.77	x	2.24	x	40.4	x	0.4	x	0.8	=	20.07	(78)
South	0.9x	0.77	x	4.01	x	40.4	x	0.4	x	0.8	=	35.92	(78)
West	0.9x	0.77	x	4.01	x	19.64	x	0.4	x	0.8	=	17.47	(80)
West	0.9x	0.77	x	1.5	x	19.64	x	0.4	x	0.8	=	6.53	(80)
West	0.9x	0.77	x	4.01	x	38.42	x	0.4	x	0.8	=	34.17	(80)
West	0.9x	0.77	x	1.5	x	38.42	x	0.4	x	0.8	=	12.78	(80)
West	0.9x	0.77	x	4.01	x	63.27	x	0.4	x	0.8	=	56.27	(80)
West	0.9x	0.77	x	1.5	x	63.27	x	0.4	x	0.8	=	21.05	(80)
West	0.9x	0.77	x	4.01	x	92.28	x	0.4	x	0.8	=	82.06	(80)
West	0.9x	0.77	x	1.5	x	92.28	x	0.4	x	0.8	=	30.7	(80)
West	0.9x	0.77	x	4.01	x	113.09	x	0.4	x	0.8	=	100.57	(80)
West	0.9x	0.77	x	1.5	x	113.09	x	0.4	x	0.8	=	37.62	(80)
West	0.9x	0.77	x	4.01	x	115.77	x	0.4	x	0.8	=	102.95	(80)
West	0.9x	0.77	x	1.5	x	115.77	x	0.4	x	0.8	=	38.51	(80)
West	0.9x	0.77	x	4.01	x	110.22	x	0.4	x	0.8	=	98.01	(80)
West	0.9x	0.77	x	1.5	x	110.22	x	0.4	x	0.8	=	36.66	(80)
West	0.9x	0.77	x	4.01	x	94.68	x	0.4	x	0.8	=	84.19	(80)
West	0.9x	0.77	x	1.5	x	94.68	x	0.4	x	0.8	=	31.49	(80)
West	0.9x	0.77	x	4.01	x	73.59	x	0.4	x	0.8	=	65.44	(80)
West	0.9x	0.77	x	1.5	x	73.59	x	0.4	x	0.8	=	24.48	(80)
West	0.9x	0.77	x	4.01	x	45.59	x	0.4	x	0.8	=	40.54	(80)
West	0.9x	0.77	x	1.5	x	45.59	x	0.4	x	0.8	=	15.16	(80)
West	0.9x	0.77	x	4.01	x	24.49	x	0.4	x	0.8	=	21.78	(80)
West	0.9x	0.77	x	1.5	x	24.49	x	0.4	x	0.8	=	8.15	(80)

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West  $0.9 \times \boxed{0.77} \times \boxed{4.01} \times \boxed{16.15} \times \boxed{0.4} \times \boxed{0.8} = \boxed{14.36}$  (80)

West  $0.9 \times \boxed{0.77} \times \boxed{1.5} \times \boxed{16.15} \times \boxed{0.4} \times \boxed{0.8} = \boxed{5.37}$  (80)

Solar gains in watts, calculated for each month

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

(83)m= 

170.44	292.34	402.65	498.92	555.65	549.38	530.66	489.25	436.43	324.07	204.58	145.54
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (83)

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

(84)m= 

580.76	700.67	798.12	873.67	909.38	882.8	850.84	815.2	772.98	681.57	586.14	545.12
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 (84)

### 7. Mean internal temperature (heating season)

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

21
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 (85)

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

(86)m= 

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.99	0.97	0.93	0.82	0.65	0.47	0.33	0.36	0.57	0.86	0.98	0.99

 (86)

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

(87)m= 

20.29	20.49	20.71	20.9	20.98	21	21	21	20.99	20.88	20.55	20.25
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 (87)

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

(88)m= 

20.18	20.18	20.18	20.19	20.19	20.2	20.2	20.2	20.2	20.19	20.19	20.18
-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------

 (88)

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

(89)m= 

0.99	0.97	0.91	0.78	0.6	0.41	0.27	0.3	0.51	0.82	0.97	0.99
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 (89)

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

(90)m= 

19.25	19.53	19.83	20.08	20.17	20.2	20.2	20.2	20.19	20.06	19.62	19.19
-------	-------	-------	-------	-------	------	------	------	-------	-------	-------	-------

 (90)

fLA = Living area ÷ (4) = 

0.36
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 (91)

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

(92)m= 

19.62	19.87	20.15	20.37	20.46	20.48	20.49	20.49	20.48	20.36	19.96	19.57
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 (92)

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

(93)m= 

19.62	19.87	20.15	20.37	20.46	20.48	20.49	20.49	20.48	20.36	19.96	19.57
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (93)

### 8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m= 

0.99	0.96	0.91	0.79	0.62	0.43	0.29	0.32	0.53	0.83	0.97	0.99
------	------	------	------	------	------	------	------	------	------	------	------

 (94)

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

(95)m= 

573.01	675.08	725.55	690.11	560.39	378.99	250.87	263.18	410.05	567.35	566.57	539.85
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 (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
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 (96)

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

(97)m= 

1019.1	993.65	903.64	751.1	572.25	380	250.94	263.32	413.75	637.31	843.65	1013.3
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 (97)

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

(98)m= 

331.89	214.08	132.5	43.91	8.82	0	0	0	0	52.05	199.5	352.25
--------	--------	-------	-------	------	---	---	---	---	-------	-------	--------

 (98)

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

1335
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 (98)

Space heating requirement in kWh/m<sup>2</sup>/year

17.85
-------

 (99)

### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

## DER WorkSheet: New dwelling design stage

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)
<i>The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.</i>		
Fraction of heat from Community boilers	1	(303a)
Fraction of total space heat from Community boilers <span style="float: right;">(302) x (303a) =</span>	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system	1	(305)
Distribution loss factor (Table 12c) for community heating system	1.1	(306)
<b>Space heating</b>	<b>kWh/year</b>	
Annual space heating requirement	1335	
Space heat from Community boilers <span style="float: right;">(98) x (304a) x (305) x (306) =</span>	1468.5	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0	(308)
Space heating requirement from secondary/supplementary system <span style="float: right;">(98) x (301) x 100 ÷ (308) =</span>	0	(309)
<b>Water heating</b>		
Annual water heating requirement	2069.63	
If DHW from community scheme: Water heat from Community boilers <span style="float: right;">(64) x (303a) x (305) x (306) =</span>	2276.59	(310a)
Electricity used for heat distribution <span style="float: right;">0.01 x [(307a)...(307e) + (310a)...(310e)] =</span>	37.45	(313)
Cooling System Energy Efficiency Ratio	0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0) <span style="float: right;">= (107) ÷ (314) =</span>	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	157.19	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year <span style="float: right;">=(330a) + (330b) + (330g) =</span>	157.19	(331)
Energy for lighting (calculated in Appendix L)	327.85	(332)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)				
Efficiency of heat source 1 (%) <span style="float: right;"><i>If there is CHP using two fuels repeat (363) to (366) for the second fuel</i></span>			95	(367a)
CO2 associated with heat source 1 <span style="float: right;">[(307b)+(310b)] x 100 ÷ (367b) x</span>		0.22	=	851.52 (367)
Electrical energy for heat distribution <span style="float: right;">[(313) x</span>		0.52	=	19.44 (372)
Total CO2 associated with community systems <span style="float: right;">(363)...(366) + (368)...(372)</span>			=	870.95 (373)
CO2 associated with space heating (secondary) <span style="float: right;">(309) x</span>		0	=	0 (374)
CO2 associated with water from immersion heater or instantaneous heater <span style="float: right;">(312) x</span>		0.22	=	0 (375)
Total CO2 associated with space and water heating <span style="float: right;">(373) + (374) + (375) =</span>				870.95 (376)
CO2 associated with electricity for pumps and fans within dwelling <span style="float: right;">(331) x</span>		0.52	=	81.58 (378)

## DER WorkSheet: New dwelling design stage

CO2 associated with electricity for lighting	(332)) x	0.52	=	170.15	(379)
<b>Total CO2, kg/year</b>	sum of (376)...(382) =			1122.68	(383)
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =			15.01	(384)
<b>EI rating (section 14)</b>				87.44	(385)

## TER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

### Property Address: GT 103 - Be Lean

**Address :** GT 103, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	74.8	(1a) x	2.6	(2a) =	194.48 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.8	(4)			
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =				194.48 (5)

### 2. Ventilation rate:

	main heating		secondary heating		other		total			m <sup>3</sup> 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							3	x 10 =	30	(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) =	30	÷ (5) =	0.15	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration			0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.4	(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>				
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.37	(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
---------	------	------	------	-----	------	------	------	------	---	------	------	------



# TER WorkSheet: New dwelling design stage

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

0.48	0.47	0.46	0.41	0.4	0.36	0.36	0.35	0.37	0.4	0.42	0.44
------	------	------	------	-----	------	------	------	------	-----	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.6
------	------	-----	------	------	------	------	------	------	------	------	-----

 (24d)

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

(25)m= 

0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.6
------	------	-----	------	------	------	------	------	------	------	------	-----

 (25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			3.41	x1/[1/(1.4)+0.04] =	4.52		(27)
Windows Type 2			3.36	x1/[1/(1.4)+0.04] =	4.45		(27)
Windows Type 3			1.91	x1/[1/(1.4)+0.04] =	2.53		(27)
Windows Type 4			1.91	x1/[1/(1.4)+0.04] =	2.53		(27)
Windows Type 5			3.41	x1/[1/(1.4)+0.04] =	4.52		(27)
Windows Type 6			3.41	x1/[1/(1.4)+0.04] =	4.52		(27)
Windows Type 7			1.28	x1/[1/(1.4)+0.04] =	1.7		(27)
Floor			74.8	x	0.13	= 9.724	(28)
Walls	61.39	18.69	42.7	x	0.18	= 7.69	(29)
Total area of elements, m <sup>2</sup>			136.19				(31)
Party wall			52.57	x	0	= 0	(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 42.19 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.57 (36)

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

Total fabric heat loss (33) + (36) = 48.76 (37)

# TER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	39.38	39.1	38.82	37.52	37.27	36.14	36.14	35.93	36.58	37.27	37.77	38.28	(38)

Heat transfer coefficient, W/K

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

(39)m=	88.14	87.86	87.58	86.28	86.03	84.9	84.9	84.69	85.33	86.03	86.53	87.04	
Average = Sum(39) <sub>1...12</sub> / 12 =												86.28	(39)

Heat loss parameter (HLP), W/m<sup>2</sup>K

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

(40)m=	1.18	1.17	1.17	1.15	1.15	1.13	1.13	1.13	1.14	1.15	1.16	1.16	
Average = Sum(40) <sub>1...12</sub> / 12 =												1.15	(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

2.36

(42)

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

if TFA ≤ 13.9, N = 1

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

90.17

(43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	99.19	95.58	91.98	88.37	84.76	81.16	81.16	84.76	88.37	91.98	95.58	99.19	
Total = Sum(44) <sub>1...12</sub> =												1082.09	(44)

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

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=	147.1	128.65	132.76	115.74	111.06	95.83	88.8	101.9	103.12	120.18	131.18	142.46	
Total = Sum(45) <sub>1...12</sub> =												1418.79	(45)

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

(46)m=	22.06	19.3	19.91	17.36	16.66	14.38	13.32	15.29	15.47	18.03	19.68	21.37	(46)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Water storage loss:

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

150

(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):

1.39

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

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

0.75

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0.75

(55)

Water storage loss calculated for each month

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

# TER WorkSheet: New dwelling design stage

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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(62)m=	193.69	170.74	179.35	160.83	157.65	140.93	135.4	148.5	148.21	166.77	176.28	189.05	(62)
--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	------

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	193.69	170.74	179.35	160.83	157.65	140.93	135.4	148.5	148.21	166.77	176.28	189.05		
Output from water heater (annual) <sup>1...12</sup>													1967.41	(64)

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

(65)m=	86.19	76.45	81.42	74.56	74.2	67.94	66.8	71.16	70.36	77.24	79.69	84.64	(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=	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	(66)

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

(67)m=	18.56	16.49	13.41	10.15	7.59	6.41	6.92	9	12.08	15.33	17.9	19.08	(67)
--------	-------	-------	-------	-------	------	------	------	---	-------	-------	------	-------	------

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

(68)m=	208.23	210.39	204.95	193.36	178.72	164.97	155.78	153.62	159.07	170.66	185.29	199.04	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	(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=	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	115.84	113.76	109.43	103.55	99.73	94.36	89.79	95.64	97.72	103.81	110.68	113.77	(72)
--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	--------	------

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

(73)m=	403.99	401.99	389.14	368.41	347.4	327.09	313.85	319.62	330.22	351.16	375.22	393.24	(73)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

## 6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
--------------	---------------------------	------------------------	------------------	----------------	----------------	--------------

## TER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	3.41	x	19.64	x	0.63	x	0.7	=	20.47	(76)
East	0.9x	0.77	x	3.41	x	38.42	x	0.63	x	0.7	=	40.04	(76)
East	0.9x	0.77	x	3.41	x	63.27	x	0.63	x	0.7	=	65.94	(76)
East	0.9x	0.77	x	3.41	x	92.28	x	0.63	x	0.7	=	96.17	(76)
East	0.9x	0.77	x	3.41	x	113.09	x	0.63	x	0.7	=	117.86	(76)
East	0.9x	0.77	x	3.41	x	115.77	x	0.63	x	0.7	=	120.65	(76)
East	0.9x	0.77	x	3.41	x	110.22	x	0.63	x	0.7	=	114.86	(76)
East	0.9x	0.77	x	3.41	x	94.68	x	0.63	x	0.7	=	98.67	(76)
East	0.9x	0.77	x	3.41	x	73.59	x	0.63	x	0.7	=	76.69	(76)
East	0.9x	0.77	x	3.41	x	45.59	x	0.63	x	0.7	=	47.51	(76)
East	0.9x	0.77	x	3.41	x	24.49	x	0.63	x	0.7	=	25.52	(76)
East	0.9x	0.77	x	3.41	x	16.15	x	0.63	x	0.7	=	16.83	(76)
South	0.9x	0.77	x	3.36	x	46.75	x	0.63	x	0.7	=	48.01	(78)
South	0.9x	0.77	x	1.91	x	46.75	x	0.63	x	0.7	=	27.29	(78)
South	0.9x	0.77	x	1.91	x	46.75	x	0.63	x	0.7	=	27.29	(78)
South	0.9x	0.77	x	3.41	x	46.75	x	0.63	x	0.7	=	48.72	(78)
South	0.9x	0.77	x	3.36	x	76.57	x	0.63	x	0.7	=	78.62	(78)
South	0.9x	0.77	x	1.91	x	76.57	x	0.63	x	0.7	=	44.69	(78)
South	0.9x	0.77	x	1.91	x	76.57	x	0.63	x	0.7	=	44.69	(78)
South	0.9x	0.77	x	3.41	x	76.57	x	0.63	x	0.7	=	79.79	(78)
South	0.9x	0.77	x	3.36	x	97.53	x	0.63	x	0.7	=	100.15	(78)
South	0.9x	0.77	x	1.91	x	97.53	x	0.63	x	0.7	=	56.93	(78)
South	0.9x	0.77	x	1.91	x	97.53	x	0.63	x	0.7	=	56.93	(78)
South	0.9x	0.77	x	3.41	x	97.53	x	0.63	x	0.7	=	101.64	(78)
South	0.9x	0.77	x	3.36	x	110.23	x	0.63	x	0.7	=	113.2	(78)
South	0.9x	0.77	x	1.91	x	110.23	x	0.63	x	0.7	=	64.35	(78)
South	0.9x	0.77	x	1.91	x	110.23	x	0.63	x	0.7	=	64.35	(78)
South	0.9x	0.77	x	3.41	x	110.23	x	0.63	x	0.7	=	114.88	(78)
South	0.9x	0.77	x	3.36	x	114.87	x	0.63	x	0.7	=	117.96	(78)
South	0.9x	0.77	x	1.91	x	114.87	x	0.63	x	0.7	=	67.05	(78)
South	0.9x	0.77	x	1.91	x	114.87	x	0.63	x	0.7	=	67.05	(78)
South	0.9x	0.77	x	3.41	x	114.87	x	0.63	x	0.7	=	119.71	(78)
South	0.9x	0.77	x	3.36	x	110.55	x	0.63	x	0.7	=	113.52	(78)
South	0.9x	0.77	x	1.91	x	110.55	x	0.63	x	0.7	=	64.53	(78)
South	0.9x	0.77	x	1.91	x	110.55	x	0.63	x	0.7	=	64.53	(78)
South	0.9x	0.77	x	3.41	x	110.55	x	0.63	x	0.7	=	115.21	(78)
South	0.9x	0.77	x	3.36	x	108.01	x	0.63	x	0.7	=	110.91	(78)
South	0.9x	0.77	x	1.91	x	108.01	x	0.63	x	0.7	=	63.05	(78)
South	0.9x	0.77	x	1.91	x	108.01	x	0.63	x	0.7	=	63.05	(78)
South	0.9x	0.77	x	3.41	x	108.01	x	0.63	x	0.7	=	112.56	(78)
South	0.9x	0.77	x	3.36	x	104.89	x	0.63	x	0.7	=	107.71	(78)

## TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.91	x	104.89	x	0.63	x	0.7	=	61.23	(78)
South	0.9x	0.77	x	1.91	x	104.89	x	0.63	x	0.7	=	61.23	(78)
South	0.9x	0.77	x	3.41	x	104.89	x	0.63	x	0.7	=	109.31	(78)
South	0.9x	0.77	x	3.36	x	101.89	x	0.63	x	0.7	=	104.62	(78)
South	0.9x	0.77	x	1.91	x	101.89	x	0.63	x	0.7	=	59.47	(78)
South	0.9x	0.77	x	1.91	x	101.89	x	0.63	x	0.7	=	59.47	(78)
South	0.9x	0.77	x	3.41	x	101.89	x	0.63	x	0.7	=	106.18	(78)
South	0.9x	0.77	x	3.36	x	82.59	x	0.63	x	0.7	=	84.8	(78)
South	0.9x	0.77	x	1.91	x	82.59	x	0.63	x	0.7	=	48.21	(78)
South	0.9x	0.77	x	1.91	x	82.59	x	0.63	x	0.7	=	48.21	(78)
South	0.9x	0.77	x	3.41	x	82.59	x	0.63	x	0.7	=	86.07	(78)
South	0.9x	0.77	x	3.36	x	55.42	x	0.63	x	0.7	=	56.91	(78)
South	0.9x	0.77	x	1.91	x	55.42	x	0.63	x	0.7	=	32.35	(78)
South	0.9x	0.77	x	1.91	x	55.42	x	0.63	x	0.7	=	32.35	(78)
South	0.9x	0.77	x	3.41	x	55.42	x	0.63	x	0.7	=	57.75	(78)
South	0.9x	0.77	x	3.36	x	40.4	x	0.63	x	0.7	=	41.48	(78)
South	0.9x	0.77	x	1.91	x	40.4	x	0.63	x	0.7	=	23.58	(78)
South	0.9x	0.77	x	1.91	x	40.4	x	0.63	x	0.7	=	23.58	(78)
South	0.9x	0.77	x	3.41	x	40.4	x	0.63	x	0.7	=	42.1	(78)
West	0.9x	0.77	x	3.41	x	19.64	x	0.63	x	0.7	=	20.47	(80)
West	0.9x	0.77	x	1.28	x	19.64	x	0.63	x	0.7	=	7.68	(80)
West	0.9x	0.77	x	3.41	x	38.42	x	0.63	x	0.7	=	40.04	(80)
West	0.9x	0.77	x	1.28	x	38.42	x	0.63	x	0.7	=	15.03	(80)
West	0.9x	0.77	x	3.41	x	63.27	x	0.63	x	0.7	=	65.94	(80)
West	0.9x	0.77	x	1.28	x	63.27	x	0.63	x	0.7	=	24.75	(80)
West	0.9x	0.77	x	3.41	x	92.28	x	0.63	x	0.7	=	96.17	(80)
West	0.9x	0.77	x	1.28	x	92.28	x	0.63	x	0.7	=	36.1	(80)
West	0.9x	0.77	x	3.41	x	113.09	x	0.63	x	0.7	=	117.86	(80)
West	0.9x	0.77	x	1.28	x	113.09	x	0.63	x	0.7	=	44.24	(80)
West	0.9x	0.77	x	3.41	x	115.77	x	0.63	x	0.7	=	120.65	(80)
West	0.9x	0.77	x	1.28	x	115.77	x	0.63	x	0.7	=	45.29	(80)
West	0.9x	0.77	x	3.41	x	110.22	x	0.63	x	0.7	=	114.86	(80)
West	0.9x	0.77	x	1.28	x	110.22	x	0.63	x	0.7	=	43.12	(80)
West	0.9x	0.77	x	3.41	x	94.68	x	0.63	x	0.7	=	98.67	(80)
West	0.9x	0.77	x	1.28	x	94.68	x	0.63	x	0.7	=	37.04	(80)
West	0.9x	0.77	x	3.41	x	73.59	x	0.63	x	0.7	=	76.69	(80)
West	0.9x	0.77	x	1.28	x	73.59	x	0.63	x	0.7	=	28.79	(80)
West	0.9x	0.77	x	3.41	x	45.59	x	0.63	x	0.7	=	47.51	(80)
West	0.9x	0.77	x	1.28	x	45.59	x	0.63	x	0.7	=	17.83	(80)
West	0.9x	0.77	x	3.41	x	24.49	x	0.63	x	0.7	=	25.52	(80)
West	0.9x	0.77	x	1.28	x	24.49	x	0.63	x	0.7	=	9.58	(80)

## TER WorkSheet: New dwelling design stage

West  $0.9 \times \boxed{0.77} \times \boxed{3.41} \times \boxed{16.15} \times \boxed{0.63} \times \boxed{0.7} = \boxed{16.83}$  (80)

West  $0.9 \times \boxed{0.77} \times \boxed{1.28} \times \boxed{16.15} \times \boxed{0.63} \times \boxed{0.7} = \boxed{6.32}$  (80)

Solar gains in watts, calculated for each month

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

(83)m=	199.93	342.92	472.29	585.2	651.73	644.37	622.42	573.85	511.91	380.14	239.98	170.73	(83)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(84)m=	603.92	744.91	861.43	953.61	999.13	971.45	936.26	893.47	842.13	731.29	615.2	563.97	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	------

### 7. Mean internal temperature (heating season)

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

21
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 (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	0.95	0.87	0.73	0.55	0.4	0.43	0.66	0.91	0.98	0.99	(86)

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

(87)m=	19.91	20.14	20.43	20.73	20.91	20.98	21	21	20.96	20.71	20.25	19.87	(87)
--------	-------	-------	-------	-------	-------	-------	----	----	-------	-------	-------	-------	------

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

(88)m=	19.94	19.94	19.94	19.96	19.96	19.97	19.97	19.97	19.97	19.96	19.95	19.95	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.97	0.93	0.83	0.67	0.46	0.31	0.34	0.58	0.87	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	18.51	18.85	19.26	19.67	19.88	19.96	19.97	19.97	19.94	19.65	19.01	18.46	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 

0.36
------

 (91)

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

(92)m=	19.01	19.31	19.68	20.05	20.25	20.33	20.34	20.34	20.3	20.03	19.46	18.97	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

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

(93)m=	19.01	19.31	19.68	20.05	20.25	20.33	20.34	20.34	20.3	20.03	19.46	18.97	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

### 8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.93	0.84	0.69	0.49	0.34	0.37	0.6	0.87	0.97	0.99	(94)
--------	------	------	------	------	------	------	------	------	-----	------	------	------	------

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

(95)m=	596.37	721.63	799.26	798.39	686.16	479	316.57	332.24	509.47	639.25	598.13	558.69	(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=	1296.71	1266.29	1154.22	961.73	735.64	486.34	317.43	333.63	529.48	811.29	1069.24	1285.33	(97)
--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(98)m=	521.05	366.02	264.09	117.6	36.81	0	0	0	0	127.99	339.2	540.62	
--------	--------	--------	--------	-------	-------	---	---	---	---	--------	-------	--------	--

Total per year (kWh/year) = Sum(98)...59...12 = 

2313.38
---------

 (98)

Space heating requirement in kWh/m<sup>2</sup>/year 

30.93
-------

 (99)

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

**Space heating:**

Fraction of space heat from secondary/supplementary system 

0
---

 (201)

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Fraction of space heat from main system(s)	$(202) = 1 - (201) =$	1	(202)
Fraction of total heating from main system 1	$(204) = (202) \times [1 - (203)] =$	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement (calculated above)													kWh/year	
	521.05	366.02	264.09	117.6	36.81	0	0	0	0	127.99	339.2	540.62		
$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$													(211)	
	557.27	391.46	282.45	125.78	39.37	0	0	0	0	136.89	362.78	578.2		
	$Total (kWh/year) = Sum(211)_{1..5,10..12} =$												2474.21	(211)

Space heating fuel (secondary), kWh/month					
$= \{[(98)m \times (201)]\} \times 100 \div (208)$					
$(215)m =$	0	0	0		
	0	0	0		
	0	0	0		
	0	0	0		
	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)														
	193.69	170.74	179.35											
	160.83	157.65	140.93											
	135.4	148.5	148.21											
	166.77	176.28	189.05											
Efficiency of water heater				79.8	(216)									
$(217)m =$	87.33	86.8	85.84	83.99	81.63	79.8	79.8	79.8	79.8	84.12	86.53	87.46	(217)	
Fuel for water heating, kWh/month														
$(219)m = (64)m \times 100 \div (217)m$														
$(219)m =$	221.8	196.71	208.93	191.48	193.14	176.6	169.67	186.09	185.73	198.26	203.71	216.15		
	$Total = Sum(219a)_{1..12} =$												2348.27	(219)

### Annual totals

	<b>kWh/year</b>	<b>kWh/year</b>	
Space heating fuel used, main system 1	2474.21		
Water heating fuel used		2348.27	
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		327.85	(232)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	=	0.216	=	534.43	(261)
Space heating (secondary)	(215) x	=	0.519	=	0	(263)
Water heating	(219) x	=	0.216	=	507.23	(264)
Space and water heating	$(261) + (262) + (263) + (264) =$				1041.66	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	=	0.519	=	38.93	(267)
Electricity for lighting	(232) x	=	0.519	=	170.15	(268)

## TER WorkSheet: New dwelling design stage

Total CO2, kg/year

sum of (265)...(271) =

1250.73 (272)

**TER =**

16.72 (273)



# DER WorkSheet: New dwelling design stage

## User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

## Property Address: GT 105 - Be Lean

**Address :** GT 105, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	<b>Area(m<sup>2</sup>)</b>		<b>Av. Height(m)</b>		<b>Volume(m<sup>3</sup>)</b>
Ground floor	72.1 (1a)	x	2.6 (2a)	=	187.46 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	72.1 (4)				
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =				187.46 (5)

### 2. Ventilation rate:

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

					<b>Air changes per hour</b>
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)	
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>					
Number of storeys in the dwelling (ns)			0	(9)	
Additional infiltration		[(9)-1]x0.1 =	0	(10)	
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0	(11)	
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)	
If no draught lobby, enter 0.05, else enter 0			0	(13)	
Percentage of windows and doors draught stripped			0	(14)	
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)	
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)	
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			2	(17)	
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.1	(18)	
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>					
Number of sides sheltered			2	(19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)	
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.08	(21)	

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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1
------	------	-----	------	------	------	------	------	------	------	-----	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24d)

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

(25)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (25)

**3. Heat losses and heat loss parameter:**

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			2.24	x1/[1/( 1.4 )+ 0.04] =	2.97		(27)
Windows Type 2			1.5	x1/[1/( 1.4 )+ 0.04] =	1.99		(27)
Windows Type 3			6.73	x1/[1/( 1.4 )+ 0.04] =	8.92		(27)
Windows Type 4			2.24	x1/[1/( 1.4 )+ 0.04] =	2.97		(27)
Floor			72.1	x 0.1 =	7.21		(28)
Walls	33.8	12.71	21.09	x 0.12 =	2.53		(29)
Total area of elements, m <sup>2</sup>			105.9				(31)
Party wall			54.21	x 0 =	0		(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 26.59 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.5 (36)

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

Total fabric heat loss (33) + (36) = 32.09 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	13.97	13.84	13.71	13.05	12.92	12.26	12.26	12.13	12.53	12.92	13.18	13.45

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

(39)m=	46.06	45.93	45.8	45.14	45.01	44.35	44.35	44.22	44.62	45.01	45.27	45.54
	Average = Sum(39) <sub>1...12</sub> /12=											45.11 (39)

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Heat loss parameter (HLP), W/m<sup>2</sup>K

(40)m = (39)m ÷ (4)

(40)m=	0.64	0.64	0.64	0.63	0.62	0.62	0.62	0.61	0.62	0.62	0.63	0.63	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.63	(40)

Number of days in month (Table 1a)

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

**4. Water heating energy requirement: kWh/year:**

Assumed occupancy, N 2.3 (42)

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

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 88.73 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	97.6	94.05	90.5	86.96	83.41	79.86	79.86	83.41	86.96	90.5	94.05	97.6	(44)
Total = Sum(44) <sub>1...12</sub> =												1064.76	

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	144.74	126.59	130.63	113.89	109.28	94.3	87.38	100.27	101.47	118.25	129.08	140.18	(45)
Total = Sum(45) <sub>1...12</sub> =												1396.07	

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

(46)m= 21.71 18.99 19.59 17.08 16.39 14.14 13.11 15.04 15.22 17.74 19.36 21.03 (46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	200.02	176.52	185.91	167.38	164.56	147.79	142.66	155.55	154.96	173.53	182.58	195.45	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	200.02	176.52	185.91	167.38	164.56	147.79	142.66	155.55	154.96	173.53	182.58	195.45	
Output from water heater (annual) <sub>1...12</sub>												(64)	
												2046.91	

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

(65)m=	92.35	82.03	87.66	80.66	80.56	74.15	73.28	77.56	76.53	83.54	85.72	90.83	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	(66)

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

(67)m=	18.14	16.11	13.1	9.92	7.41	6.26	6.76	8.79	11.8	14.98	17.48	18.64	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	202.15	204.25	198.96	187.71	173.5	160.15	151.23	149.13	154.42	165.67	179.88	193.23	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	(69)
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Pumps and fans gains (Table 5a)

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

(71)m=	-91.84	-91.84	-91.84	-91.84	-91.84	-91.84	-91.84	-91.84	-91.84	-91.84	-91.84	-91.84	(71)
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Water heating gains (Table 5)

(72)m=	124.12	122.07	117.82	112.03	108.28	102.99	98.49	104.25	106.3	112.29	119.05	122.08	(72)
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**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	401.85	399.87	387.32	367.1	346.63	326.83	313.92	319.61	329.95	350.38	373.85	391.39	(73)
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## 6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub>g</sub> Table 6b	FF Table 6c	Gains (W)							
North	0.9x	0.77	x	1.5	x	10.63	x	0.4	x	0.8	=	3.54	(74)
North	0.9x	0.77	x	6.73	x	10.63	x	0.4	x	0.8	=	15.87	(74)
North	0.9x	0.77	x	2.24	x	10.63	x	0.4	x	0.8	=	5.28	(74)
North	0.9x	0.77	x	1.5	x	20.32	x	0.4	x	0.8	=	6.76	(74)
North	0.9x	0.77	x	6.73	x	20.32	x	0.4	x	0.8	=	30.33	(74)

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North	0.9x	0.77	x	2.24	x	20.32	x	0.4	x	0.8	=	10.09	(74)
North	0.9x	0.77	x	1.5	x	34.53	x	0.4	x	0.8	=	11.49	(74)
North	0.9x	0.77	x	6.73	x	34.53	x	0.4	x	0.8	=	51.53	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.4	x	0.8	=	17.15	(74)
North	0.9x	0.77	x	1.5	x	55.46	x	0.4	x	0.8	=	18.45	(74)
North	0.9x	0.77	x	6.73	x	55.46	x	0.4	x	0.8	=	82.78	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.4	x	0.8	=	27.55	(74)
North	0.9x	0.77	x	1.5	x	74.72	x	0.4	x	0.8	=	24.85	(74)
North	0.9x	0.77	x	6.73	x	74.72	x	0.4	x	0.8	=	111.51	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.4	x	0.8	=	37.11	(74)
North	0.9x	0.77	x	1.5	x	79.99	x	0.4	x	0.8	=	26.61	(74)
North	0.9x	0.77	x	6.73	x	79.99	x	0.4	x	0.8	=	119.37	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.4	x	0.8	=	39.73	(74)
North	0.9x	0.77	x	1.5	x	74.68	x	0.4	x	0.8	=	24.84	(74)
North	0.9x	0.77	x	6.73	x	74.68	x	0.4	x	0.8	=	111.45	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.4	x	0.8	=	37.1	(74)
North	0.9x	0.77	x	1.5	x	59.25	x	0.4	x	0.8	=	19.71	(74)
North	0.9x	0.77	x	6.73	x	59.25	x	0.4	x	0.8	=	88.42	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.4	x	0.8	=	29.43	(74)
North	0.9x	0.77	x	1.5	x	41.52	x	0.4	x	0.8	=	13.81	(74)
North	0.9x	0.77	x	6.73	x	41.52	x	0.4	x	0.8	=	61.96	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.4	x	0.8	=	20.62	(74)
North	0.9x	0.77	x	1.5	x	24.19	x	0.4	x	0.8	=	8.05	(74)
North	0.9x	0.77	x	6.73	x	24.19	x	0.4	x	0.8	=	36.1	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.4	x	0.8	=	12.02	(74)
North	0.9x	0.77	x	1.5	x	13.12	x	0.4	x	0.8	=	4.36	(74)
North	0.9x	0.77	x	6.73	x	13.12	x	0.4	x	0.8	=	19.58	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.4	x	0.8	=	6.52	(74)
North	0.9x	0.77	x	1.5	x	8.86	x	0.4	x	0.8	=	2.95	(74)
North	0.9x	0.77	x	6.73	x	8.86	x	0.4	x	0.8	=	13.23	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.4	x	0.8	=	4.4	(74)
South	0.9x	0.77	x	2.24	x	46.75	x	0.4	x	0.8	=	23.22	(78)
South	0.9x	0.77	x	2.24	x	76.57	x	0.4	x	0.8	=	38.03	(78)
South	0.9x	0.77	x	2.24	x	97.53	x	0.4	x	0.8	=	48.45	(78)
South	0.9x	0.77	x	2.24	x	110.23	x	0.4	x	0.8	=	54.76	(78)
South	0.9x	0.77	x	2.24	x	114.87	x	0.4	x	0.8	=	57.06	(78)
South	0.9x	0.77	x	2.24	x	110.55	x	0.4	x	0.8	=	54.91	(78)
South	0.9x	0.77	x	2.24	x	108.01	x	0.4	x	0.8	=	53.65	(78)
South	0.9x	0.77	x	2.24	x	104.89	x	0.4	x	0.8	=	52.11	(78)
South	0.9x	0.77	x	2.24	x	101.89	x	0.4	x	0.8	=	50.61	(78)
South	0.9x	0.77	x	2.24	x	82.59	x	0.4	x	0.8	=	41.02	(78)

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South  $0.9 \times \boxed{0.77} \times \boxed{2.24} \times \boxed{55.42} \times \boxed{0.4} \times \boxed{0.8} = \boxed{27.53}$  (78)

South  $0.9 \times \boxed{0.77} \times \boxed{2.24} \times \boxed{40.4} \times \boxed{0.4} \times \boxed{0.8} = \boxed{20.07}$  (78)

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

(83)m=	47.91	85.22	128.62	183.54	230.54	240.63	227.04	189.67	147.01	97.19	57.98	40.65	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	449.76	485.08	515.94	550.63	577.17	567.46	540.96	509.28	476.96	447.57	431.84	432.04	(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
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 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.89	0.71	0.5	0.36	0.4	0.64	0.91	0.99	1	(86)

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

(87)m=	20.54	20.63	20.76	20.92	20.99	21	21	21	21	20.91	20.71	20.52	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.4	20.4	20.4	20.41	20.41	20.42	20.42	20.42	20.41	20.41	20.4	20.4	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.96	0.87	0.67	0.45	0.31	0.35	0.59	0.89	0.98	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.78	19.91	20.1	20.32	20.4	20.42	20.42	20.42	20.41	20.31	20.03	19.75	(90)
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$fLA = \text{Living area} \div (4) = \boxed{0.37}$  (91)

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

(92)m=	20.06	20.17	20.35	20.54	20.62	20.63	20.63	20.63	20.63	20.54	20.28	20.04	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	20.06	20.17	20.35	20.54	20.62	20.63	20.63	20.63	20.63	20.54	20.28	20.04	(93)
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### 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	
(94)m=	0.99	0.98	0.96	0.87	0.69	0.47	0.33	0.37	0.61	0.89	0.98	0.99	(94)

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

(95)m=	446.41	477.75	495.54	479.84	395.37	267.28	178.81	187.16	289.45	399.88	423.47	429.59	(95)
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Monthly average external temperature from Table 8

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

(97)m=	725.81	701.46	634.18	525.41	401.31	267.51	178.82	187.18	291.19	447.23	596.68	721.11	(97)
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Space heating requirement for each month, kWh/month =  $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	207.87	150.33	103.15	32.81	4.42	0	0	0	0	35.23	124.71	216.89		
$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1...5,9...12} =$												<table border="1" style="display: inline-table;"><tr><td style="width: 100px; text-align: center;">875.4</td></tr></table>	875.4	(98)
875.4														

Space heating requirement in kWh/m<sup>2</sup>/year 

12.14
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 (99)

### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

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Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)
<i>The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.</i>		
Fraction of heat from Community boilers	1	(303a)
Fraction of total space heat from Community boilers <span style="float: right;">(302) x (303a) =</span>	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system	1	(305)
Distribution loss factor (Table 12c) for community heating system	1.1	(306)
<b>kWh/year</b>		
<b>Space heating</b>		
Annual space heating requirement	875.4	
Space heat from Community boilers <span style="float: right;">(98) x (304a) x (305) x (306) =</span>	962.94	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0	(308)
Space heating requirement from secondary/supplementary system <span style="float: right;">(98) x (301) x 100 ÷ (308) =</span>	0	(309)
<b>Water heating</b>		
Annual water heating requirement	2046.91	
If DHW from community scheme: Water heat from Community boilers <span style="float: right;">(64) x (303a) x (305) x (306) =</span>	2251.6	(310a)
Electricity used for heat distribution <span style="float: right;">0.01 x [(307a)...(307e) + (310a)...(310e)] =</span>	32.15	(313)
Cooling System Energy Efficiency Ratio	0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0) <span style="float: right;">= (107) ÷ (314) =</span>	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	151.51	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year <span style="float: right;">=(330a) + (330b) + (330g) =</span>	151.51	(331)
Energy for lighting (calculated in Appendix L)	320.27	(332)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)				
Efficiency of heat source 1 (%) <span style="float: right;"><i>If there is CHP using two fuels repeat (363) to (366) for the second fuel</i></span>			95	(367a)
CO2 associated with heat source 1 <span style="float: right;">[(307b)+(310b)] x 100 ÷ (367b) x</span>		0.22	=	730.89 (367)
Electrical energy for heat distribution <span style="float: right;">[(313) x</span>		0.52	=	16.68 (372)
Total CO2 associated with community systems <span style="float: right;">(363)...(366) + (368)...(372)</span>			=	747.57 (373)
CO2 associated with space heating (secondary) <span style="float: right;">(309) x</span>		0	=	0 (374)
CO2 associated with water from immersion heater or instantaneous heater <span style="float: right;">(312) x</span>		0.22	=	0 (375)
Total CO2 associated with space and water heating <span style="float: right;">(373) + (374) + (375) =</span>				747.57 (376)
CO2 associated with electricity for pumps and fans within dwelling <span style="float: right;">(331) x</span>		0.52	=	78.64 (378)

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CO2 associated with electricity for lighting	(332)) x	0.52	=	166.22	(379)
<b>Total CO2, kg/year</b>	sum of (376)...(382) =			992.43	(383)
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =			13.76	(384)
<b>EI rating (section 14)</b>				88.64	(385)



## TER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

### Property Address: GT 105 - Be Lean

**Address :** GT 105, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	<b>Area(m<sup>2</sup>)</b>		<b>Av. Height(m)</b>		<b>Volume(m<sup>3</sup>)</b>
Ground floor	72.1	(1a) x	2.6	(2a) =	187.46
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	72.1	(4)			
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =				187.46

### 2. Ventilation rate:

	main heating	+	secondary heating	+	other	=	total	x	m <sup>3</sup> per hour
Number of chimneys	0		0		0	=	0	x 40 =	0
Number of open flues	0		0		0	=	0	x 20 =	0
Number of intermittent fans					3	=	3	x 10 =	30
Number of passive vents					0	=	0	x 10 =	0
Number of flueless gas fires					0	=	0	x 40 =	0

### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.16	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.41	(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.35	(21)

Infiltration rate modified for monthly wind speed

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

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

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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# TER WorkSheet: New dwelling design stage

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

0.44	0.44	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:  (23a)

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

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

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

(24a)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58
-----	------	------	------	------	------	------	------	------	------	------	------

(24d)

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

(25)m= 

0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58
-----	------	------	------	------	------	------	------	------	------	------	------

(25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			<input type="text" value="2.24"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.97"/>		(27)
Windows Type 2			<input type="text" value="1.5"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.99"/>		(27)
Windows Type 3			<input type="text" value="6.73"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="8.92"/>		(27)
Windows Type 4			<input type="text" value="2.24"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.97"/>		(27)
Floor			<input type="text" value="72.1"/>	$x$ <input type="text" value="0.13"/>	$=$ <input type="text" value="9.372999"/>	<input type="text"/>	(28)
Walls	<input type="text" value="33.8"/>	<input type="text" value="12.71"/>	<input type="text" value="21.09"/>	$x$ <input type="text" value="0.18"/>	$=$ <input type="text" value="3.8"/>	<input type="text"/>	(29)
Total area of elements, m <sup>2</sup>			<input type="text" value="105.9"/>				(31)
Party wall			<input type="text" value="54.21"/>	$x$ <input type="text" value="0"/>	$=$ <input type="text" value="0"/>	<input type="text"/>	(32)

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

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

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

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium  (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  (36)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	37.04	36.8	36.57	35.48	35.27	34.32	34.32	34.15	34.69	35.27	35.69	36.12

(38)

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

(39)m=	70.88	70.64	70.41	69.32	69.11	68.16	68.16	67.99	68.53	69.11	69.53	69.96
	Average = Sum(39) <sub>1...12</sub> /12=											
	<input type="text" value="69.32"/> (39)											

# TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.98	0.98	0.98	0.96	0.96	0.95	0.95	0.94	0.95	0.96	0.96	0.97	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.96	(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 2.3 (42)  
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)  
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 88.73 (43)  
 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	97.6	94.05	90.5	86.96	83.41	79.86	79.86	83.41	86.96	90.5	94.05	97.6	(44)
Total = Sum(44) <sub>1...12</sub> =												1064.76	

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	144.74	126.59	130.63	113.89	109.28	94.3	87.38	100.27	101.47	118.25	129.08	140.18	(45)
Total = Sum(45) <sub>1...12</sub> =												1396.07	

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	21.71	18.99	19.59	17.08	16.39	14.14	13.11	15.04	15.22	17.74	19.36	21.03	(46)

Water storage loss:  
 Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (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) 0.75 (55)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m  
 (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(62)m=	191.34	168.68	177.23	158.98	155.87	139.39	133.98	146.87	146.56	164.85	174.17	186.77	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	191.34	168.68	177.23	158.98	155.87	139.39	133.98	146.87	146.56	164.85	174.17	186.77	
Output from water heater (annual) <sub>1...12</sub>												(64)	
												1944.69	

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

(65)m=	85.4	75.76	80.71	73.94	73.61	67.43	66.33	70.62	69.81	76.6	78.99	83.88	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	(66)

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

(67)m=	18.47	16.4	13.34	10.1	7.55	6.37	6.89	8.95	12.02	15.26	17.81	18.98	(67)
--------	-------	------	-------	------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	202.15	204.25	198.96	187.71	173.5	160.15	151.23	149.13	154.42	165.67	179.88	193.23	(68)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	(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=	-91.84	-91.84	-91.84	-91.84	-91.84	-91.84	-91.84	-91.84	-91.84	-91.84	-91.84	-91.84	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	114.79	112.74	108.48	102.7	98.94	93.65	89.15	94.91	96.96	102.95	109.71	112.75	(72)
--------	--------	--------	--------	-------	-------	-------	-------	-------	-------	--------	--------	--------	------

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

(73)m=	395.85	393.83	381.22	360.94	340.43	320.61	307.71	313.44	323.84	344.32	367.84	385.4	(73)
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## 6. Solar gains:

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

Orientation:	Access Factor Table 6d	x	Area m <sup>2</sup>	x	Flux Table 6a	x	g <sub>g</sub> Table 6b	x	FF Table 6c	=	Gains (W)			
North	0.9x		0.77	x	1.5	x	10.63	x	0.63	x	0.7	=	4.87	(74)
North	0.9x		0.77	x	6.73	x	10.63	x	0.63	x	0.7	=	21.87	(74)
North	0.9x		0.77	x	2.24	x	10.63	x	0.63	x	0.7	=	7.28	(74)
North	0.9x		0.77	x	1.5	x	20.32	x	0.63	x	0.7	=	9.32	(74)
North	0.9x		0.77	x	6.73	x	20.32	x	0.63	x	0.7	=	41.8	(74)

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North	0.9x	0.77	x	2.24	x	20.32	x	0.63	x	0.7	=	13.91	(74)
North	0.9x	0.77	x	1.5	x	34.53	x	0.63	x	0.7	=	15.83	(74)
North	0.9x	0.77	x	6.73	x	34.53	x	0.63	x	0.7	=	71.02	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.63	x	0.7	=	23.64	(74)
North	0.9x	0.77	x	1.5	x	55.46	x	0.63	x	0.7	=	25.43	(74)
North	0.9x	0.77	x	6.73	x	55.46	x	0.63	x	0.7	=	114.08	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.63	x	0.7	=	37.97	(74)
North	0.9x	0.77	x	1.5	x	74.72	x	0.63	x	0.7	=	34.25	(74)
North	0.9x	0.77	x	6.73	x	74.72	x	0.63	x	0.7	=	153.67	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.63	x	0.7	=	51.15	(74)
North	0.9x	0.77	x	1.5	x	79.99	x	0.63	x	0.7	=	36.67	(74)
North	0.9x	0.77	x	6.73	x	79.99	x	0.63	x	0.7	=	164.51	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.63	x	0.7	=	54.76	(74)
North	0.9x	0.77	x	1.5	x	74.68	x	0.63	x	0.7	=	34.23	(74)
North	0.9x	0.77	x	6.73	x	74.68	x	0.63	x	0.7	=	153.59	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.63	x	0.7	=	51.12	(74)
North	0.9x	0.77	x	1.5	x	59.25	x	0.63	x	0.7	=	27.16	(74)
North	0.9x	0.77	x	6.73	x	59.25	x	0.63	x	0.7	=	121.86	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.63	x	0.7	=	40.56	(74)
North	0.9x	0.77	x	1.5	x	41.52	x	0.63	x	0.7	=	19.03	(74)
North	0.9x	0.77	x	6.73	x	41.52	x	0.63	x	0.7	=	85.39	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.63	x	0.7	=	28.42	(74)
North	0.9x	0.77	x	1.5	x	24.19	x	0.63	x	0.7	=	11.09	(74)
North	0.9x	0.77	x	6.73	x	24.19	x	0.63	x	0.7	=	49.75	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.63	x	0.7	=	16.56	(74)
North	0.9x	0.77	x	1.5	x	13.12	x	0.63	x	0.7	=	6.01	(74)
North	0.9x	0.77	x	6.73	x	13.12	x	0.63	x	0.7	=	26.98	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.63	x	0.7	=	8.98	(74)
North	0.9x	0.77	x	1.5	x	8.86	x	0.63	x	0.7	=	4.06	(74)
North	0.9x	0.77	x	6.73	x	8.86	x	0.63	x	0.7	=	18.23	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.63	x	0.7	=	6.07	(74)
South	0.9x	0.77	x	2.24	x	46.75	x	0.63	x	0.7	=	32.01	(78)
South	0.9x	0.77	x	2.24	x	76.57	x	0.63	x	0.7	=	52.42	(78)
South	0.9x	0.77	x	2.24	x	97.53	x	0.63	x	0.7	=	66.77	(78)
South	0.9x	0.77	x	2.24	x	110.23	x	0.63	x	0.7	=	75.46	(78)
South	0.9x	0.77	x	2.24	x	114.87	x	0.63	x	0.7	=	78.64	(78)
South	0.9x	0.77	x	2.24	x	110.55	x	0.63	x	0.7	=	75.68	(78)
South	0.9x	0.77	x	2.24	x	108.01	x	0.63	x	0.7	=	73.94	(78)
South	0.9x	0.77	x	2.24	x	104.89	x	0.63	x	0.7	=	71.81	(78)
South	0.9x	0.77	x	2.24	x	101.89	x	0.63	x	0.7	=	69.75	(78)
South	0.9x	0.77	x	2.24	x	82.59	x	0.63	x	0.7	=	56.54	(78)

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South  $0.9 \times \boxed{0.77} \times \boxed{2.24} \times \boxed{55.42} \times \boxed{0.63} \times \boxed{0.7} = \boxed{37.94}$  (78)

South  $0.9 \times \boxed{0.77} \times \boxed{2.24} \times \boxed{40.4} \times \boxed{0.63} \times \boxed{0.7} = \boxed{27.66}$  (78)

Solar gains in watts, calculated for each month

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

(83)m= 

66.03	117.44	177.26	252.94	317.71	331.61	312.89	261.38	202.59	133.94	79.91	56.02
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 (83)

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

(84)m= 

461.88	511.27	558.48	613.88	658.14	652.23	620.6	574.82	526.43	478.26	447.75	441.42
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 (84)

### 7. Mean internal temperature (heating season)

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

21
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 (85)

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

(86)m= 

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.99	0.99	0.95	0.84	0.65	0.48	0.54	0.8	0.97	0.99	1

 (86)

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

(87)m= 

20.03	20.15	20.37	20.66	20.88	20.98	21	20.99	20.93	20.65	20.3	20.01
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 (87)

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

(88)m= 

20.1	20.1	20.1	20.12	20.12	20.13	20.13	20.13	20.12	20.12	20.11	20.11
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 (88)

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

(89)m= 

1	0.99	0.98	0.93	0.8	0.57	0.39	0.44	0.73	0.95	0.99	1
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 (89)

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

(90)m= 

18.8	18.99	19.29	19.71	20	20.12	20.13	20.13	20.07	19.72	19.2	18.78
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 (90)

fLA = Living area ÷ (4) = 

0.37
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 (91)

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

(92)m= 

19.25	19.42	19.69	20.06	20.33	20.44	20.45	20.45	20.39	20.06	19.61	19.23
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 (92)

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

(93)m= 

19.25	19.42	19.69	20.06	20.33	20.44	20.45	20.45	20.39	20.06	19.61	19.23
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (93)

### 8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m= 

1	0.99	0.98	0.93	0.81	0.6	0.42	0.48	0.76	0.95	0.99	1
---	------	------	------	------	-----	------	------	------	------	------	---

 (94)

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

(95)m= 

459.6	506.46	546.07	572.24	532	389.06	261.39	273.37	398.72	454.76	443.08	439.71
-------	--------	--------	--------	-----	--------	--------	--------	--------	--------	--------	--------

 (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= 

1059.87	1025.49	928.75	773.59	596.29	397.74	262.33	275.23	431.07	654.03	869.56	1051.81
---------	---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	---------

 (97)

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

(98)m= 

446.6	348.79	284.71	144.97	47.83	0	0	0	0	148.26	307.06	455.41
-------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

Total per year (kWh/year) = Sum(98)...59...12 = 

2183.63
---------

 (98)

Space heating requirement in kWh/m<sup>2</sup>/year 

30.29
-------

 (99)

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

**Space heating:**

Fraction of space heat from secondary/supplementary system 

0
---

 (201)

## TER WorkSheet: New dwelling design stage

Fraction of space heat from main system(s)	$(202) = 1 - (201) =$	1	(202)
Fraction of total heating from main system 1	$(204) = (202) \times [1 - (203)] =$	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement (calculated above)													kWh/year	
	446.6	348.79	284.71	144.97	47.83	0	0	0	0	148.26	307.06	455.41		
$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$													(211)	
	477.65	373.04	304.51	155.05	51.15	0	0	0	0	158.57	328.41	487.07		
	$Total (kWh/year) = Sum(211)_{1..5,10..12} =$												2335.44	(211)

Space heating fuel (secondary), kWh/month					
$= \{[(98)m \times (201)]\} \times 100 \div (208)$					
$(215)m =$	0	0	0		
	0	0	0		
	0	0	0		
	0	0	0		
	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)														
	191.34	168.68	177.23											
	158.98	155.87	139.39											
	133.98	146.87	146.56											
	164.85	174.17	186.77											
Efficiency of water heater													79.8	(216)
$(217)m =$	87	86.71	86.07											
	84.57	82.08	79.8											
	79.8	79.8	79.8											
	79.8	84.53	86.31											
	87.1												(217)	
Fuel for water heating, kWh/month														
$(219)m = (64)m \times 100 \div (217)m$														
$(219)m =$	219.93	194.53	205.91											
	187.99	189.91	174.68											
	167.89	184.04	183.66											
	195.01	201.8	214.42											
	$Total = Sum(219a)_{1..12} =$												2319.77	(219)

### Annual totals

	<b>kWh/year</b>	<b>kWh/year</b>	
Space heating fuel used, main system 1		2335.44	
Water heating fuel used		2319.77	
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		326.18	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	504.45	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	501.07	(264)
Space and water heating	$(261) + (262) + (263) + (264) =$			1005.52	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	169.29	(268)

# TER WorkSheet: New dwelling design stage

Total CO2, kg/year

sum of (265)...(271) =

1213.74

(272)

**TER =**

16.83

(273)



# DER WorkSheet: New dwelling design stage

## User Details:

**Assessor Name:** John Simpson      **Stroma Number:** STRO006273  
**Software Name:** Stroma FSAP 2012      **Software Version:** Version: 1.0.5.8

## Property Address: GT 106 - Be Lean

**Address :** GT 106, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )	Av. Height(m)	Volume(m <sup>3</sup> )
Ground floor	73.5 (1a)	2.6 (2a)	191.1 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.5 (4)		
Dwelling volume			191.1 (5)

### 2. Ventilation rate:

	main heating	secondary heating	other	total	m <sup>3</sup> per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			2 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.1 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.08 (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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## DER WorkSheet: New dwelling design stage

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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1
------	------	-----	------	------	------	------	------	------	------	-----	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24d)

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

(25)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			4.47	$x1/[1/(1.4)+0.04] =$	5.93		(27)
Windows Type 2			2.24	$x1/[1/(1.4)+0.04] =$	2.97		(27)
Windows Type 3			9.25	$x1/[1/(1.4)+0.04] =$	12.26		(27)
Windows Type 4			2.24	$x1/[1/(1.4)+0.04] =$	2.97		(27)
Walls	46.28	18.2	28.08	x 0.12	= 3.37		(29)
Total area of elements, m <sup>2</sup>			46.28				(31)
Party wall			42.85	x 0	= 0		(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 27.5 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.97 (36)

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

Total fabric heat loss (33) + (36) = 34.47 (37)

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

(38)m= 

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
14.24	14.11	13.98	13.31	13.17	12.5	12.5	12.37	12.77	13.17	13.44	13.71

 (38)

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

(39)m= 

48.71	48.58	48.45	47.78	47.64	46.97	46.97	46.84	47.24	47.64	47.91	48.18
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Average = Sum(39)<sub>1...12</sub> /12= 47.74 (39)

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Heat loss parameter (HLP), W/m<sup>2</sup>K

(40)m = (39)m ÷ (4)

(40)m=	0.66	0.66	0.66	0.65	0.65	0.64	0.64	0.64	0.64	0.65	0.65	0.66	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.65	(40)

Number of days in month (Table 1a)

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

### 4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N 2.33 (42)

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

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 89.49 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	98.44	94.86	91.28	87.7	84.12	80.54	80.54	84.12	87.7	91.28	94.86	98.44	(44)
Total = Sum(44) <sub>1...12</sub> =												1073.88	

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	145.98	127.68	131.75	114.86	110.22	95.11	88.13	101.13	102.34	119.27	130.19	141.38	(45)
Total = Sum(45) <sub>1...12</sub> =												1408.03	

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

(46)m= 21.9 19.15 19.76 17.23 16.53 14.27 13.22 15.17 15.35 17.89 19.53 21.21 (46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	201.26	177.6	187.03	168.36	165.49	148.6	143.41	156.41	155.83	174.54	183.68	196.65	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	201.26	177.6	187.03	168.36	165.49	148.6	143.41	156.41	155.83	174.54	183.68	196.65		
<b>Output from water heater (annual)<sub>1...12</sub></b>												2058.87	(64)	

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

(65)m=	92.76	82.39	88.03	80.99	80.87	74.42	73.52	77.85	76.82	83.88	86.08	91.23	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.4	116.4	116.4	116.4	116.4	116.4	116.4	116.4	116.4	116.4	116.4	116.4	(66)

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

(67)m=	18.3	16.26	13.22	10.01	7.48	6.32	6.83	8.87	11.91	15.12	17.65	18.81	(67)
--------	------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	205.32	207.45	202.09	190.66	176.23	162.67	153.61	151.48	156.85	168.28	182.7	196.26	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	------

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

(69)m=	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

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

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

(71)m=	-93.12	-93.12	-93.12	-93.12	-93.12	-93.12	-93.12	-93.12	-93.12	-93.12	-93.12	-93.12	(71)
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Water heating gains (Table 5)

(72)m=	124.68	122.61	118.32	112.48	108.69	103.36	98.82	104.63	106.7	112.74	119.56	122.62	(72)
--------	--------	--------	--------	--------	--------	--------	-------	--------	-------	--------	--------	--------	------

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

(73)m=	406.23	404.24	391.55	371.07	350.32	330.26	317.18	322.9	333.37	354.05	377.83	395.62	(73)
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### 6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub>g</sub> Table 6b	FF Table 6c	Gains (W)							
North	0.9x	0.77	x	2.24	x	10.63	x	0.4	x	0.8	=	5.28	(74)
North	0.9x	0.77	x	9.25	x	10.63	x	0.4	x	0.8	=	21.81	(74)
North	0.9x	0.77	x	2.24	x	20.32	x	0.4	x	0.8	=	10.09	(74)
North	0.9x	0.77	x	9.25	x	20.32	x	0.4	x	0.8	=	41.68	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.4	x	0.8	=	17.15	(74)

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North	0.9x	0.77	x	9.25	x	34.53	x	0.4	x	0.8	=	70.83	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.4	x	0.8	=	27.55	(74)
North	0.9x	0.77	x	9.25	x	55.46	x	0.4	x	0.8	=	113.77	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.4	x	0.8	=	37.11	(74)
North	0.9x	0.77	x	9.25	x	74.72	x	0.4	x	0.8	=	153.26	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.4	x	0.8	=	39.73	(74)
North	0.9x	0.77	x	9.25	x	79.99	x	0.4	x	0.8	=	164.07	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.4	x	0.8	=	37.1	(74)
North	0.9x	0.77	x	9.25	x	74.68	x	0.4	x	0.8	=	153.18	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.4	x	0.8	=	29.43	(74)
North	0.9x	0.77	x	9.25	x	59.25	x	0.4	x	0.8	=	121.53	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.4	x	0.8	=	20.62	(74)
North	0.9x	0.77	x	9.25	x	41.52	x	0.4	x	0.8	=	85.16	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.4	x	0.8	=	12.02	(74)
North	0.9x	0.77	x	9.25	x	24.19	x	0.4	x	0.8	=	49.62	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.4	x	0.8	=	6.52	(74)
North	0.9x	0.77	x	9.25	x	13.12	x	0.4	x	0.8	=	26.91	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.4	x	0.8	=	4.4	(74)
North	0.9x	0.77	x	9.25	x	8.86	x	0.4	x	0.8	=	18.18	(74)
South	0.9x	0.77	x	4.47	x	46.75	x	0.4	x	0.8	=	46.34	(78)
South	0.9x	0.77	x	2.24	x	46.75	x	0.4	x	0.8	=	23.22	(78)
South	0.9x	0.77	x	4.47	x	76.57	x	0.4	x	0.8	=	75.9	(78)
South	0.9x	0.77	x	2.24	x	76.57	x	0.4	x	0.8	=	38.03	(78)
South	0.9x	0.77	x	4.47	x	97.53	x	0.4	x	0.8	=	96.68	(78)
South	0.9x	0.77	x	2.24	x	97.53	x	0.4	x	0.8	=	48.45	(78)
South	0.9x	0.77	x	4.47	x	110.23	x	0.4	x	0.8	=	109.27	(78)
South	0.9x	0.77	x	2.24	x	110.23	x	0.4	x	0.8	=	54.76	(78)
South	0.9x	0.77	x	4.47	x	114.87	x	0.4	x	0.8	=	113.87	(78)
South	0.9x	0.77	x	2.24	x	114.87	x	0.4	x	0.8	=	57.06	(78)
South	0.9x	0.77	x	4.47	x	110.55	x	0.4	x	0.8	=	109.58	(78)
South	0.9x	0.77	x	2.24	x	110.55	x	0.4	x	0.8	=	54.91	(78)
South	0.9x	0.77	x	4.47	x	108.01	x	0.4	x	0.8	=	107.07	(78)
South	0.9x	0.77	x	2.24	x	108.01	x	0.4	x	0.8	=	53.65	(78)
South	0.9x	0.77	x	4.47	x	104.89	x	0.4	x	0.8	=	103.98	(78)
South	0.9x	0.77	x	2.24	x	104.89	x	0.4	x	0.8	=	52.11	(78)
South	0.9x	0.77	x	4.47	x	101.89	x	0.4	x	0.8	=	101	(78)
South	0.9x	0.77	x	2.24	x	101.89	x	0.4	x	0.8	=	50.61	(78)
South	0.9x	0.77	x	4.47	x	82.59	x	0.4	x	0.8	=	81.86	(78)
South	0.9x	0.77	x	2.24	x	82.59	x	0.4	x	0.8	=	41.02	(78)
South	0.9x	0.77	x	4.47	x	55.42	x	0.4	x	0.8	=	54.93	(78)
South	0.9x	0.77	x	2.24	x	55.42	x	0.4	x	0.8	=	27.53	(78)

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South  $0.9 \times \boxed{0.77} \times \boxed{4.47} \times \boxed{40.4} \times \boxed{0.4} \times \boxed{0.8} = \boxed{40.05}$  (78)

South  $0.9 \times \boxed{0.77} \times \boxed{2.24} \times \boxed{40.4} \times \boxed{0.4} \times \boxed{0.8} = \boxed{20.07}$  (78)

Solar gains in watts, calculated for each month

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

(83)m=	96.66	165.71	233.12	305.35	361.31	368.3	351	307.05	257.39	184.52	115.89	82.7	(83)
--------	-------	--------	--------	--------	--------	-------	-----	--------	--------	--------	--------	------	------

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

(84)m=	502.89	569.96	624.66	676.42	711.63	698.56	668.18	629.95	590.76	538.58	493.72	478.32	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

### 7. Mean internal temperature (heating season)

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

21
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 (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	0.93	0.81	0.62	0.43	0.31	0.34	0.55	0.85	0.98	0.99	(86)

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

(87)m=	20.56	20.68	20.83	20.96	20.99	21	21	21	21	20.95	20.74	20.53	(87)
--------	-------	-------	-------	-------	-------	----	----	----	----	-------	-------	-------	------

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

(88)m=	20.37	20.38	20.38	20.39	20.39	20.39	20.39	20.4	20.39	20.39	20.38	20.38	(88)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.97	0.92	0.78	0.58	0.39	0.27	0.3	0.5	0.82	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	-----	-----	------	------	------	------

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

(90)m=	19.79	19.97	20.18	20.34	20.38	20.39	20.39	20.4	20.39	20.33	20.06	19.75	(90)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 

0.33
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 (91)

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

(92)m=	20.04	20.2	20.39	20.54	20.58	20.59	20.59	20.59	20.59	20.53	20.28	20.01	(92)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	20.04	20.2	20.39	20.54	20.58	20.59	20.59	20.59	20.59	20.53	20.28	20.01	(93)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

### 8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.92	0.79	0.59	0.4	0.28	0.31	0.52	0.83	0.97	0.99	(94)
--------	------	------	------	------	------	-----	------	------	------	------	------	------	------

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

(95)m=	496.79	552.51	574.26	531.97	420.71	281.42	187.57	196.45	305.9	444.38	477.31	474.07	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	766.78	743.42	672.96	556.2	423.22	281.51	187.58	196.46	306.58	473.27	631.53	761.62	(97)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	200.87	128.29	73.43	17.45	1.87	0	0	0	0	21.5	111.04	213.93	
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Total per year (kWh/year) = Sum(98)...5,9...12 = 

768.39
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 (98)

Space heating requirement in kWh/m<sup>2</sup>/year 

10.45
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 (99)

### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

## DER WorkSheet: New dwelling design stage

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)
<i>The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.</i>		
Fraction of heat from Community boilers	1	(303a)
Fraction of total space heat from Community boilers <span style="float: right;">(302) x (303a) =</span>	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system	1	(305)
Distribution loss factor (Table 12c) for community heating system	1.1	(306)
<b>Space heating</b>		
<b>kWh/year</b>		
Annual space heating requirement	768.39	
Space heat from Community boilers <span style="float: right;">(98) x (304a) x (305) x (306) =</span>	845.23	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0	(308)
Space heating requirement from secondary/supplementary system <span style="float: right;">(98) x (301) x 100 ÷ (308) =</span>	0	(309)
<b>Water heating</b>		
Annual water heating requirement	2058.87	
If DHW from community scheme: Water heat from Community boilers <span style="float: right;">(64) x (303a) x (305) x (306) =</span>	2264.76	(310a)
Electricity used for heat distribution <span style="float: right;">0.01 x [(307a)...(307e) + (310a)...(310e)] =</span>	31.1	(313)
Cooling System Energy Efficiency Ratio	0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0) <span style="float: right;">= (107) ÷ (314) =</span>	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	154.46	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year <span style="float: right;">=(330a) + (330b) + (330g) =</span>	154.46	(331)
Energy for lighting (calculated in Appendix L)	323.27	(332)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)				
Efficiency of heat source 1 (%) <span style="float: right;"><i>If there is CHP using two fuels repeat (363) to (366) for the second fuel</i></span>			95	(367a)
CO2 associated with heat source 1 <span style="float: right;">[(307b)+(310b)] x 100 ÷ (367b) x</span>		0.22	=	707.11 (367)
Electrical energy for heat distribution <span style="float: right;">[(313) x</span>		0.52	=	16.14 (372)
Total CO2 associated with community systems <span style="float: right;">(363)...(366) + (368)...(372)</span>			=	723.25 (373)
CO2 associated with space heating (secondary) <span style="float: right;">(309) x</span>		0	=	0 (374)
CO2 associated with water from immersion heater or instantaneous heater <span style="float: right;">(312) x</span>		0.22	=	0 (375)
Total CO2 associated with space and water heating <span style="float: right;">(373) + (374) + (375) =</span>				723.25 (376)
CO2 associated with electricity for pumps and fans within dwelling <span style="float: right;">(331) x</span>		0.52	=	80.16 (378)

## DER WorkSheet: New dwelling design stage

CO2 associated with electricity for lighting	(332)) x	0.52	=	167.78	(379)
<b>Total CO2, kg/year</b>	sum of (376)...(382) =			971.19	(383)
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =			13.21	(384)
<b>EI rating (section 14)</b>				89.02	(385)



## TER WorkSheet: New dwelling design stage

### User Details:

**Assessor Name:** John Simpson                      **Stroma Number:** STRO006273  
**Software Name:** Stroma FSAP 2012                  **Software Version:** Version: 1.0.5.8

Property Address: GT 106 - Be Lean

**Address :** GT 106, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	73.5	(1a) x	2.6	(2a) =	191.1
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.5	(4)			
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =				191.1

### 2. Ventilation rate:

	main heating	+	secondary heating	+	other	=	total			m <sup>3</sup> per hour
Number of chimneys	0		0		0	=	0	x 40 =		0
Number of open flues	0		0		0	=	0	x 20 =		0
Number of intermittent fans					3		3	x 10 =		30
Number of passive vents					0		0	x 10 =		0
Number of flueless gas fires					0		0	x 40 =		0

### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.16	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.41	(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.35	(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
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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# TER WorkSheet: New dwelling design stage

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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:  (23a)

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

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

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

(24a)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58
-----	------	------	------	------	------	------	------	------	------	------	------

(24d)

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

(25)m= 

0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58
-----	------	------	------	------	------	------	------	------	------	------	------

(25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			<input type="text" value="4.47"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="5.93"/>		(27)
Windows Type 2			<input type="text" value="2.24"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.97"/>		(27)
Windows Type 3			<input type="text" value="9.25"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="12.26"/>		(27)
Windows Type 4			<input type="text" value="2.24"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.97"/>		(27)
Walls	<input type="text" value="46.28"/>	<input type="text" value="18.2"/>	<input type="text" value="28.08"/>	$x$ <input type="text" value="0.18"/>	$=$ <input type="text" value="5.05"/>		(29)
Total area of elements, m <sup>2</sup>			<input type="text" value="46.28"/>				(31)
Party wall			<input type="text" value="42.85"/>	$x$ <input type="text" value="0"/>	$=$ <input type="text" value="0"/>		(32)

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

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

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

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium  (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  (36)

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

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

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

(38)m= 

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
37.67	37.43	37.19	36.1	35.89	34.94	34.94	34.76	35.3	35.89	36.31	36.74

(38)

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

(39)m= 

71.62	71.39	71.15	70.06	69.85	68.9	68.9	68.72	69.26	69.85	70.27	70.7
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Average = Sum(39)<sub>1...12</sub> /12=  (39)

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Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.97	0.97	0.97	0.95	0.95	0.94	0.94	0.93	0.94	0.95	0.96	0.96	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.95	(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 2.33 (42)

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

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 89.49 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	98.44	94.86	91.28	87.7	84.12	80.54	80.54	84.12	87.7	91.28	94.86	98.44	(44)
Total = Sum(44) <sub>1...12</sub> =												1073.88	

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	145.98	127.68	131.75	114.86	110.22	95.11	88.13	101.13	102.34	119.27	130.19	141.38	(45)
Total = Sum(45) <sub>1...12</sub> =												1408.03	

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

(46)m= 21.9 19.15 19.76 17.23 16.53 14.27 13.22 15.17 15.35 17.89 19.53 21.21 (46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (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) 0.75 (55)

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

(56)m= 23.33 21.07 23.33 22.58 23.33 22.58 23.33 23.33 22.58 23.33 22.58 23.33 (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= 23.33 21.07 23.33 22.58 23.33 22.58 23.33 23.33 22.58 23.33 22.58 23.33 (57)

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

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

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

(59)m= 23.26 21.01 23.26 22.51 23.26 22.51 23.26 23.26 22.51 23.26 22.51 23.26 (59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(62)m=	192.58	169.76	178.35	159.96	156.81	140.2	134.73	147.73	147.43	165.86	175.28	187.97	(62)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	192.58	169.76	178.35	159.96	156.81	140.2	134.73	147.73	147.43	165.86	175.28	187.97	Output from water heater (annual) <sup>1...12</sup>		(64)
												1956.65			

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

(65)m=	85.82	76.12	81.08	74.27	73.92	67.7	66.58	70.9	70.1	76.93	79.36	84.28	(65)
--------	-------	-------	-------	-------	-------	------	-------	------	------	-------	-------	-------	------

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.4	116.4	116.4	116.4	116.4	116.4	116.4	116.4	116.4	116.4	116.4	116.4	(66)

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

(67)m=	18.3	16.26	13.22	10.01	7.48	6.32	6.83	8.87	11.91	15.12	17.65	18.81	(67)
--------	------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	205.32	207.45	202.09	190.66	176.23	162.67	153.61	151.48	156.85	168.28	182.7	196.26	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	------

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

(69)m=	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	34.64	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-93.12	-93.12	-93.12	-93.12	-93.12	-93.12	-93.12	-93.12	-93.12	-93.12	-93.12	-93.12	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	115.34	113.28	108.98	103.15	99.36	94.02	89.49	95.3	97.36	103.4	110.22	113.28	(72)
--------	--------	--------	--------	--------	-------	-------	-------	------	-------	-------	--------	--------	------

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

(73)m=	399.89	397.91	385.21	364.73	343.99	323.93	310.84	316.57	327.04	347.72	371.5	389.28	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	------

## 6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m <sup>2</sup>		Flux Table 6a		g <sub>g</sub> Table 6b		FF Table 6c		Gains (W)		
North	0.9x	0.77	x	2.24	x	10.63	x	0.63	x	0.7	=	7.28	(74)
North	0.9x	0.77	x	9.25	x	10.63	x	0.63	x	0.7	=	30.06	(74)
North	0.9x	0.77	x	2.24	x	20.32	x	0.63	x	0.7	=	13.91	(74)
North	0.9x	0.77	x	9.25	x	20.32	x	0.63	x	0.7	=	57.45	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.63	x	0.7	=	23.64	(74)

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North	0.9x	0.77	x	9.25	x	34.53	x	0.63	x	0.7	=	97.61	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.63	x	0.7	=	37.97	(74)
North	0.9x	0.77	x	9.25	x	55.46	x	0.63	x	0.7	=	156.79	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.63	x	0.7	=	51.15	(74)
North	0.9x	0.77	x	9.25	x	74.72	x	0.63	x	0.7	=	211.22	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.63	x	0.7	=	54.76	(74)
North	0.9x	0.77	x	9.25	x	79.99	x	0.63	x	0.7	=	226.11	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.63	x	0.7	=	51.12	(74)
North	0.9x	0.77	x	9.25	x	74.68	x	0.63	x	0.7	=	211.1	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.63	x	0.7	=	40.56	(74)
North	0.9x	0.77	x	9.25	x	59.25	x	0.63	x	0.7	=	167.48	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.63	x	0.7	=	28.42	(74)
North	0.9x	0.77	x	9.25	x	41.52	x	0.63	x	0.7	=	117.36	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.63	x	0.7	=	16.56	(74)
North	0.9x	0.77	x	9.25	x	24.19	x	0.63	x	0.7	=	68.38	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.63	x	0.7	=	8.98	(74)
North	0.9x	0.77	x	9.25	x	13.12	x	0.63	x	0.7	=	37.08	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.63	x	0.7	=	6.07	(74)
North	0.9x	0.77	x	9.25	x	8.86	x	0.63	x	0.7	=	25.06	(74)
South	0.9x	0.77	x	4.47	x	46.75	x	0.63	x	0.7	=	63.87	(78)
South	0.9x	0.77	x	2.24	x	46.75	x	0.63	x	0.7	=	32.01	(78)
South	0.9x	0.77	x	4.47	x	76.57	x	0.63	x	0.7	=	104.6	(78)
South	0.9x	0.77	x	2.24	x	76.57	x	0.63	x	0.7	=	52.42	(78)
South	0.9x	0.77	x	4.47	x	97.53	x	0.63	x	0.7	=	133.24	(78)
South	0.9x	0.77	x	2.24	x	97.53	x	0.63	x	0.7	=	66.77	(78)
South	0.9x	0.77	x	4.47	x	110.23	x	0.63	x	0.7	=	150.59	(78)
South	0.9x	0.77	x	2.24	x	110.23	x	0.63	x	0.7	=	75.46	(78)
South	0.9x	0.77	x	4.47	x	114.87	x	0.63	x	0.7	=	156.92	(78)
South	0.9x	0.77	x	2.24	x	114.87	x	0.63	x	0.7	=	78.64	(78)
South	0.9x	0.77	x	4.47	x	110.55	x	0.63	x	0.7	=	151.02	(78)
South	0.9x	0.77	x	2.24	x	110.55	x	0.63	x	0.7	=	75.68	(78)
South	0.9x	0.77	x	4.47	x	108.01	x	0.63	x	0.7	=	147.55	(78)
South	0.9x	0.77	x	2.24	x	108.01	x	0.63	x	0.7	=	73.94	(78)
South	0.9x	0.77	x	4.47	x	104.89	x	0.63	x	0.7	=	143.3	(78)
South	0.9x	0.77	x	2.24	x	104.89	x	0.63	x	0.7	=	71.81	(78)
South	0.9x	0.77	x	4.47	x	101.89	x	0.63	x	0.7	=	139.18	(78)
South	0.9x	0.77	x	2.24	x	101.89	x	0.63	x	0.7	=	69.75	(78)
South	0.9x	0.77	x	4.47	x	82.59	x	0.63	x	0.7	=	112.82	(78)
South	0.9x	0.77	x	2.24	x	82.59	x	0.63	x	0.7	=	56.54	(78)
South	0.9x	0.77	x	4.47	x	55.42	x	0.63	x	0.7	=	75.7	(78)
South	0.9x	0.77	x	2.24	x	55.42	x	0.63	x	0.7	=	37.94	(78)

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South  $0.9 \times \boxed{0.77} \times \boxed{4.47} \times \boxed{40.4} \times \boxed{0.63} \times \boxed{0.7} = \boxed{55.19}$  (78)

South  $0.9 \times \boxed{0.77} \times \boxed{2.24} \times \boxed{40.4} \times \boxed{0.63} \times \boxed{0.7} = \boxed{27.66}$  (78)

Solar gains in watts, calculated for each month

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

(83)m=	133.21	228.37	321.26	420.82	497.93	507.56	483.72	423.15	354.72	254.3	159.7	113.97	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	------

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

(84)m=	533.1	626.28	706.47	785.55	841.91	831.49	794.56	739.71	681.76	602.02	531.2	503.25	(84)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	------

### 7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.96	0.88	0.73	0.52	0.38	0.43	0.67	0.92	0.99	1	(86)

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

(87)m=	20.12	20.3	20.53	20.8	20.95	20.99	21	21	20.97	20.77	20.4	20.09	(87)
--------	-------	------	-------	------	-------	-------	----	----	-------	-------	------	-------	------

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

(88)m=	20.1	20.11	20.11	20.12	20.12	20.14	20.14	20.14	20.13	20.12	20.12	20.12	(88)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.95	0.85	0.67	0.46	0.31	0.35	0.6	0.89	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	-----	------	------	------	------

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

(90)m=	18.94	19.2	19.54	19.9	20.08	20.13	20.14	20.14	20.11	19.88	19.36	18.9	(90)
--------	-------	------	-------	------	-------	-------	-------	-------	-------	-------	-------	------	------

fLA = Living area ÷ (4) =  (91)

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

(92)m=	19.33	19.56	19.86	20.19	20.36	20.41	20.42	20.42	20.4	20.17	19.7	19.29	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------	-------	------

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

(93)m=	19.33	19.56	19.86	20.19	20.36	20.41	20.42	20.42	20.4	20.17	19.7	19.29	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------	-------	------

### 8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.95	0.86	0.69	0.48	0.33	0.37	0.62	0.9	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	-----	------	------	------

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

(95)m=	528.33	612.83	668.87	673.38	577.87	397.86	262.84	275.73	424.35	538.95	520.12	499.87	(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=	1076.29	1046.35	950.8	791.2	605.19	400.59	263.09	276.22	436.08	668.53	885.3	1067.14	(97)
--------	---------	---------	-------	-------	--------	--------	--------	--------	--------	--------	-------	---------	------

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

(98)m=	407.68	291.33	209.76	84.83	20.32	0	0	0	0	96.41	262.93	422.05	(98)
--------	--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------	------

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

Space heating requirement in kWh/m<sup>2</sup>/year  (99)

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

**Space heating:**

Fraction of space heat from secondary/supplementary system  (201)

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Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement (calculated above)													kWh/year	
	407.68	291.33	209.76	84.83	20.32	0	0	0	0	96.41	262.93	422.05		
(211)m = {[ (98)m x (204)] } x 100 ÷ (206)													(211)	
	436.02	311.58	224.34	90.73	21.74	0	0	0	0	103.11	281.21	451.39		
	Total (kWh/year) = Sum(211) <sub>1..5,10..12</sub> =												1920.12	(211)

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

### Water heating

Output from water heater (calculated above)														
	192.58	169.76	178.35											
	159.96	156.81	140.2											
	134.73	147.73	147.43											
	165.86	175.28	187.97											
Efficiency of water heater				79.8	(216)									
(217)m =	86.77	86.24	85.25	83.21	80.9	79.8	79.8	79.8	79.8	83.43	85.89	86.91	(217)	
Fuel for water heating, kWh/month														
(219)m = (64)m x 100 ÷ (217)m														
(219)m =	221.95	196.84	209.21	192.23	193.84	175.69	168.83	185.12	184.75	198.81	204.07	216.28		
	Total = Sum(219a) <sub>1..12</sub> =												2347.63	(219)

### Annual totals

	<b>kWh/year</b>	<b>kWh/year</b>	
Space heating fuel used, main system 1	1920.12		
Water heating fuel used		2347.63	
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		323.27	(232)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	=	0.216	=	414.75	(261)
Space heating (secondary)	(215) x	=	0.519	=	0	(263)
Water heating	(219) x	=	0.216	=	507.09	(264)
Space and water heating	(261) + (262) + (263) + (264) =				921.83	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	=	0.519	=	38.93	(267)
Electricity for lighting	(232) x	=	0.519	=	167.78	(268)

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Total CO2, kg/year

sum of (265)...(271) =

1128.54

(272)

**TER =**

15.35

(273)



## DER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

Property Address: GT 107 - Be Lean

**Address :** GT 107, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	50	(1a) x	2.6	(2a) =	130 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	130 (5)

### 2. Ventilation rate:

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

#### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			2	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.1	(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>				
Number of sides sheltered			3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.08	(21)
Infiltration rate modified for monthly wind speed				

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

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

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

# DER WorkSheet: New dwelling design stage

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

0.1	0.1	0.09	0.09	0.08	0.07	0.07	0.07	0.08	0.08	0.09	0.09
-----	-----	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 

0.22	0.21	0.21	0.2	0.2	0.19	0.19	0.19	0.2	0.2	0.2	0.21
------	------	------	-----	-----	------	------	------	-----	-----	-----	------

 (24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24d)

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

(25)m= 

0.22	0.21	0.21	0.2	0.2	0.19	0.19	0.19	0.2	0.2	0.2	0.21
------	------	------	-----	-----	------	------	------	-----	-----	-----	------

 (25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			2.24	x1/[1/(1.4)+0.04] =	2.97		(27)
Windows Type 2			2.24	x1/[1/(1.4)+0.04] =	2.97		(27)
Windows Type 3			9.25	x1/[1/(1.4)+0.04] =	12.26		(27)
Windows Type 4			2.24	x1/[1/(1.4)+0.04] =	2.97		(27)
Walls	32.58	15.97	16.61	x 0.12 =	1.99		(29)
Total area of elements, m <sup>2</sup>			32.58				(31)
Party wall			57.02	x 0 =	0		(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 23.17 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.46 (36)

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

Total fabric heat loss (33) + (36) = 28.63 (37)

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

(38)m= 

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
9.28	9.2	9.11	8.7	8.61	8.2	8.2	8.12	8.37	8.61	8.78	8.95

 (38)

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

(39)m= 

37.91	37.82	37.74	37.33	37.24	36.83	36.83	36.74	36.99	37.24	37.41	37.58
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Average = Sum(39)<sub>1...12</sub> /12= 37.31 (39)

# DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m<sup>2</sup>K

(40)m = (39)m ÷ (4)

(40)m=	0.76	0.76	0.75	0.75	0.74	0.74	0.74	0.73	0.74	0.74	0.75	0.75	
	Average = Sum(40) <sub>1...12</sub> / 12 =											0.75	(40)

Number of days in month (Table 1a)

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

**4. Water heating energy requirement: kWh/year:**

Assumed occupancy, N 1.69 (42)

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

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.34 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77	
(44)m=	Total = Sum(44) <sub>1...12</sub> =											892.08	(44)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	
	Total = Sum(45) <sub>1...12</sub> =											1169.66	(45)

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

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

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

# DER WorkSheet: New dwelling design stage

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	176.55	155.99	164.72	148.91	146.83	132.5	128.49	139.29	138.51	154.35	161.64	172.72	(62)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	176.55	155.99	164.72	148.91	146.83	132.5	128.49	139.29	138.51	154.35	161.64	172.72	
Output from water heater (annual) <sub>1...12</sub>												(64)	
												1820.5	

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

(65)m=	84.54	75.21	80.61	74.52	74.66	69.06	68.56	72.15	71.06	77.16	78.75	83.27	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	(66)

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

(67)m=	13.13	11.66	9.48	7.18	5.37	4.53	4.89	6.36	8.54	10.84	12.66	13.49	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

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

Pumps and fans gains (Table 5a)

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

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

Water heating gains (Table 5)

(72)m=	113.63	111.92	108.35	103.5	100.35	95.92	92.16	96.98	98.7	103.71	109.38	111.92	(72)
--------	--------	--------	--------	-------	--------	-------	-------	-------	------	--------	--------	--------	------

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

(73)m=	322.34	320.69	311.09	295.75	280.44	265.45	255.55	260.32	268.06	283.58	301.4	314.5	(73)
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## 6. Solar gains:

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

Orientation:	Access Factor Table 6d	x	Area m <sup>2</sup>	x	Flux Table 6a	x	g <sub>g</sub> Table 6b	x	FF Table 6c	=	Gains (W)			
North	0.9x		0.77	x	2.24	x	10.63	x	0.4	x	0.8	=	5.28	(74)
North	0.9x		0.77	x	2.24	x	10.63	x	0.4	x	0.8	=	5.28	(74)
North	0.9x		0.77	x	9.25	x	10.63	x	0.4	x	0.8	=	21.81	(74)
North	0.9x		0.77	x	2.24	x	10.63	x	0.4	x	0.8	=	5.28	(74)
North	0.9x		0.77	x	2.24	x	20.32	x	0.4	x	0.8	=	10.09	(74)

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North	0.9x	0.77	x	2.24	x	20.32	x	0.4	x	0.8	=	10.09	(74)
North	0.9x	0.77	x	9.25	x	20.32	x	0.4	x	0.8	=	41.68	(74)
North	0.9x	0.77	x	2.24	x	20.32	x	0.4	x	0.8	=	10.09	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.4	x	0.8	=	17.15	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.4	x	0.8	=	17.15	(74)
North	0.9x	0.77	x	9.25	x	34.53	x	0.4	x	0.8	=	70.83	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.4	x	0.8	=	17.15	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.4	x	0.8	=	27.55	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.4	x	0.8	=	27.55	(74)
North	0.9x	0.77	x	9.25	x	55.46	x	0.4	x	0.8	=	113.77	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.4	x	0.8	=	27.55	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.4	x	0.8	=	37.11	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.4	x	0.8	=	37.11	(74)
North	0.9x	0.77	x	9.25	x	74.72	x	0.4	x	0.8	=	153.26	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.4	x	0.8	=	37.11	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.4	x	0.8	=	39.73	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.4	x	0.8	=	39.73	(74)
North	0.9x	0.77	x	9.25	x	79.99	x	0.4	x	0.8	=	164.07	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.4	x	0.8	=	39.73	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.4	x	0.8	=	37.1	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.4	x	0.8	=	37.1	(74)
North	0.9x	0.77	x	9.25	x	74.68	x	0.4	x	0.8	=	153.18	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.4	x	0.8	=	37.1	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.4	x	0.8	=	29.43	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.4	x	0.8	=	29.43	(74)
North	0.9x	0.77	x	9.25	x	59.25	x	0.4	x	0.8	=	121.53	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.4	x	0.8	=	29.43	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.4	x	0.8	=	20.62	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.4	x	0.8	=	20.62	(74)
North	0.9x	0.77	x	9.25	x	41.52	x	0.4	x	0.8	=	85.16	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.4	x	0.8	=	20.62	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.4	x	0.8	=	12.02	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.4	x	0.8	=	12.02	(74)
North	0.9x	0.77	x	9.25	x	24.19	x	0.4	x	0.8	=	49.62	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.4	x	0.8	=	12.02	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.4	x	0.8	=	6.52	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.4	x	0.8	=	6.52	(74)
North	0.9x	0.77	x	9.25	x	13.12	x	0.4	x	0.8	=	26.91	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.4	x	0.8	=	6.52	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.4	x	0.8	=	4.4	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.4	x	0.8	=	4.4	(74)

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North  $0.9 \times \boxed{0.77} \times \boxed{9.25} \times \boxed{8.86} \times \boxed{0.4} \times \boxed{0.8} = \boxed{18.18}$  (74)  
 North  $0.9 \times \boxed{0.77} \times \boxed{2.24} \times \boxed{8.86} \times \boxed{0.4} \times \boxed{0.8} = \boxed{4.4}$  (74)

Solar gains in watts, calculated for each month

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

(83)m=	37.66	71.97	122.29	196.43	264.61	283.27	264.47	209.82	147.03	85.67	46.46	31.39	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	360	392.65	433.38	492.17	545.05	548.72	520.02	470.14	415.09	369.24	347.86	345.9	(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
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 (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	0.95	0.84	0.63	0.43	0.31	0.36	0.61	0.9	0.98	0.99	(86)

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

(87)m=	20.44	20.55	20.73	20.92	20.99	21	21	21	20.99	20.89	20.64	20.42	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.29	20.29	20.29	20.3	20.3	20.31	20.31	20.31	20.31	20.3	20.3	20.3	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.94	0.81	0.58	0.38	0.26	0.31	0.55	0.87	0.97	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.55	19.71	19.96	20.21	20.29	20.31	20.31	20.31	20.3	20.18	19.84	19.52	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

fLA = Living area ÷ (4) = 

0.5
-----

 (91)

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

(92)m=	20	20.13	20.35	20.57	20.64	20.66	20.66	20.66	20.65	20.54	20.24	19.97	(92)
--------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	20	20.13	20.35	20.57	20.64	20.66	20.66	20.66	20.65	20.54	20.24	19.97	(93)
--------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

### 8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.94	0.82	0.6	0.41	0.29	0.33	0.58	0.88	0.97	0.99	(94)
--------	------	------	------	------	-----	------	------	------	------	------	------	------	------

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

(95)m=	355.94	384.11	408.48	402.71	329.28	222.81	149.35	156.36	240.23	324.64	338.86	342.81	(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)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m ]

(97)m=	595.06	576.04	522.55	435.53	333.06	223	149.36	156.4	242.28	370.02	491.56	592.58	(97)
--------	--------	--------	--------	--------	--------	-----	--------	-------	--------	--------	--------	--------	------

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

(98)m=	177.91	128.98	84.87	23.63	2.81	0	0	0	0	33.76	109.95	185.83	
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Total per year (kWh/year) = Sum(98)1...5,9...12 = 

747.73
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 (98)

Space heating requirement in kWh/m<sup>2</sup>/year 

14.95
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 (99)

### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

## DER WorkSheet: New dwelling design stage

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)
<i>The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.</i>		
Fraction of heat from Community boilers	1	(303a)
Fraction of total space heat from Community boilers <span style="float: right;">(302) x (303a) =</span>	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system	1	(305)
Distribution loss factor (Table 12c) for community heating system	1.1	(306)
<b>Space heating</b>		
<b>kWh/year</b>		
Annual space heating requirement	747.73	
Space heat from Community boilers <span style="float: right;">(98) x (304a) x (305) x (306) =</span>	822.51	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0	(308)
Space heating requirement from secondary/supplementary system <span style="float: right;">(98) x (301) x 100 ÷ (308) =</span>	0	(309)
<b>Water heating</b>		
Annual water heating requirement	1820.5	
If DHW from community scheme: Water heat from Community boilers <span style="float: right;">(64) x (303a) x (305) x (306) =</span>	2002.55	(310a)
Electricity used for heat distribution <span style="float: right;">0.01 x [(307a)...(307e) + (310a)...(310e)] =</span>	28.25	(313)
Cooling System Energy Efficiency Ratio	0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0) <span style="float: right;">= (107) ÷ (314) =</span>	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	99.12	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year <span style="float: right;">=(330a) + (330b) + (330g) =</span>	99.12	(331)
Energy for lighting (calculated in Appendix L)	231.81	(332)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
<b>CO2 from other sources of space and water heating (not CHP)</b>				
Efficiency of heat source 1 (%) <span style="float: right;"><i>If there is CHP using two fuels repeat (363) to (366) for the second fuel</i></span>			95	(367a)
CO2 associated with heat source 1 <span style="float: right;">[(307b)+(310b)] x 100 ÷ (367b) x</span>		0.22	=	642.33 (367)
Electrical energy for heat distribution <span style="float: right;">[(313) x</span>		0.52	=	14.66 (372)
Total CO2 associated with community systems <span style="float: right;">(363)...(366) + (368)...(372)</span>			=	656.99 (373)
CO2 associated with space heating (secondary) <span style="float: right;">(309) x</span>		0	=	0 (374)
CO2 associated with water from immersion heater or instantaneous heater <span style="float: right;">(312) x</span>		0.22	=	0 (375)
Total CO2 associated with space and water heating <span style="float: right;">(373) + (374) + (375) =</span>				656.99 (376)
CO2 associated with electricity for pumps and fans within dwelling <span style="float: right;">(331) x</span>		0.52	=	51.45 (378)

## DER WorkSheet: New dwelling design stage

CO2 associated with electricity for lighting	(332)) x	0.52	=	120.31	(379)
<b>Total CO2, kg/year</b>	sum of (376)...(382) =			828.74	(383)
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =			16.57	(384)
<b>EI rating (section 14)</b>				88.31	(385)



## TER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

### Property Address: GT 107 - Be Lean

**Address :** GT 107, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	50	(1a) x	2.6	(2a) =	130 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50	(4)			
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =				130 (5)

### 2. Ventilation rate:

	main heating	secondary heating	other	total		m <sup>3</sup> 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) =	0.15 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration	[(9)-1]x0.1 =		0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.4 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.31 (21)

Infiltration rate modified for monthly wind speed

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

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

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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# TER WorkSheet: New dwelling design stage

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

0.4	0.39	0.38	0.34	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37
-----	------	------	------	------	-----	-----	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:  (23a)

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

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

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

(24a)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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(24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
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(24d)

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

(25)m= 

0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
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(25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			<input type="text" value="1.75"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.32"/>		(27)
Windows Type 2			<input type="text" value="1.75"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.32"/>		(27)
Windows Type 3			<input type="text" value="7.24"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="9.6"/>		(27)
Windows Type 4			<input type="text" value="1.75"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.32"/>		(27)
Walls	<input type="text" value="32.58"/>	<input type="text" value="12.49"/>	<input type="text" value="20.09"/>	$x$ <input type="text" value="0.18"/>	$=$ <input type="text" value="3.62"/>	<input type="text"/>	(29)
Total area of elements, m <sup>2</sup>			<input type="text" value="32.58"/>				(31)
Party wall			<input type="text" value="57.02"/>	$x$ <input type="text" value="0"/>	$=$ <input type="text" value="0"/>	<input type="text"/>	(32)

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

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

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

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium  (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  (36)

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

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

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

(38)m= 

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
24.87	24.73	24.6	23.99	23.88	23.35	23.35	23.25	23.55	23.88	24.11	24.35

(38)

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

(39)m= 

48.63	48.5	48.37	47.76	47.64	47.11	47.11	47.01	47.32	47.64	47.87	48.12
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Average = Sum(39)<sub>1...12</sub> /12=  (39)

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Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.97	0.97	0.97	0.96	0.95	0.94	0.94	0.94	0.95	0.95	0.96	0.96	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.96	(40)

Number of days in month (Table 1a)

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

**4. Water heating energy requirement: kWh/year:**

Assumed occupancy, N 1.69 (42)

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

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.34 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	81.77	78.8	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.8	81.77	(44)
Total = Sum(44) <sub>1...12</sub> =												892.08	

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	(45)
Total = Sum(45) <sub>1...12</sub> =												1169.66	

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

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

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (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) 0.75 (55)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	167.86	148.15	156.04	140.51	138.15	124.1	119.81	130.61	130.11	145.67	153.24	164.04	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	167.86	148.15	156.04	140.51	138.15	124.1	119.81	130.61	130.11	145.67	153.24	164.04		
												Output from water heater (annual) <sub>1...12</sub>	(64)	
												1718.27		

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

(65)m=	77.6	68.93	73.67	67.8	67.72	62.34	61.62	65.21	64.34	70.22	72.03	76.33	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	84.51	(66)

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

(67)m=	13.13	11.66	9.48	7.18	5.37	4.53	4.89	6.36	8.54	10.84	12.66	13.49	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	147.23	148.76	144.91	136.72	126.37	116.64	110.15	108.62	112.47	120.67	131.01	140.74	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

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

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

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

Water heating gains (Table 5)

(72)m=	104.3	102.58	99.01	94.17	91.02	86.59	82.82	87.65	89.36	94.38	100.05	102.59	(72)
--------	-------	--------	-------	-------	-------	-------	-------	-------	-------	-------	--------	--------	------

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

(73)m=	316.01	314.35	304.76	289.41	274.11	259.11	249.22	253.98	261.72	277.24	295.07	308.17	(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 m <sup>2</sup>	Flux Table 6a	g <sub>g</sub> Table 6b	FF Table 6c	Gains (W)							
North	0.9x	0.77	x	1.75	x	10.63	x	0.63	x	0.7	=	5.69	(74)
North	0.9x	0.77	x	1.75	x	10.63	x	0.63	x	0.7	=	5.69	(74)
North	0.9x	0.77	x	7.24	x	10.63	x	0.63	x	0.7	=	23.53	(74)
North	0.9x	0.77	x	1.75	x	10.63	x	0.63	x	0.7	=	5.69	(74)
North	0.9x	0.77	x	1.75	x	20.32	x	0.63	x	0.7	=	10.87	(74)

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North	0.9x	0.77	x	1.75	x	20.32	x	0.63	x	0.7	=	10.87	(74)
North	0.9x	0.77	x	7.24	x	20.32	x	0.63	x	0.7	=	44.96	(74)
North	0.9x	0.77	x	1.75	x	20.32	x	0.63	x	0.7	=	10.87	(74)
North	0.9x	0.77	x	1.75	x	34.53	x	0.63	x	0.7	=	18.47	(74)
North	0.9x	0.77	x	1.75	x	34.53	x	0.63	x	0.7	=	18.47	(74)
North	0.9x	0.77	x	7.24	x	34.53	x	0.63	x	0.7	=	76.4	(74)
North	0.9x	0.77	x	1.75	x	34.53	x	0.63	x	0.7	=	18.47	(74)
North	0.9x	0.77	x	1.75	x	55.46	x	0.63	x	0.7	=	29.66	(74)
North	0.9x	0.77	x	1.75	x	55.46	x	0.63	x	0.7	=	29.66	(74)
North	0.9x	0.77	x	7.24	x	55.46	x	0.63	x	0.7	=	122.72	(74)
North	0.9x	0.77	x	1.75	x	55.46	x	0.63	x	0.7	=	29.66	(74)
North	0.9x	0.77	x	1.75	x	74.72	x	0.63	x	0.7	=	39.96	(74)
North	0.9x	0.77	x	1.75	x	74.72	x	0.63	x	0.7	=	39.96	(74)
North	0.9x	0.77	x	7.24	x	74.72	x	0.63	x	0.7	=	165.32	(74)
North	0.9x	0.77	x	1.75	x	74.72	x	0.63	x	0.7	=	39.96	(74)
North	0.9x	0.77	x	1.75	x	79.99	x	0.63	x	0.7	=	42.78	(74)
North	0.9x	0.77	x	1.75	x	79.99	x	0.63	x	0.7	=	42.78	(74)
North	0.9x	0.77	x	7.24	x	79.99	x	0.63	x	0.7	=	176.98	(74)
North	0.9x	0.77	x	1.75	x	79.99	x	0.63	x	0.7	=	42.78	(74)
North	0.9x	0.77	x	1.75	x	74.68	x	0.63	x	0.7	=	39.94	(74)
North	0.9x	0.77	x	1.75	x	74.68	x	0.63	x	0.7	=	39.94	(74)
North	0.9x	0.77	x	7.24	x	74.68	x	0.63	x	0.7	=	165.23	(74)
North	0.9x	0.77	x	1.75	x	74.68	x	0.63	x	0.7	=	39.94	(74)
North	0.9x	0.77	x	1.75	x	59.25	x	0.63	x	0.7	=	31.69	(74)
North	0.9x	0.77	x	1.75	x	59.25	x	0.63	x	0.7	=	31.69	(74)
North	0.9x	0.77	x	7.24	x	59.25	x	0.63	x	0.7	=	131.09	(74)
North	0.9x	0.77	x	1.75	x	59.25	x	0.63	x	0.7	=	31.69	(74)
North	0.9x	0.77	x	1.75	x	41.52	x	0.63	x	0.7	=	22.2	(74)
North	0.9x	0.77	x	1.75	x	41.52	x	0.63	x	0.7	=	22.2	(74)
North	0.9x	0.77	x	7.24	x	41.52	x	0.63	x	0.7	=	91.86	(74)
North	0.9x	0.77	x	1.75	x	41.52	x	0.63	x	0.7	=	22.2	(74)
North	0.9x	0.77	x	1.75	x	24.19	x	0.63	x	0.7	=	12.94	(74)
North	0.9x	0.77	x	1.75	x	24.19	x	0.63	x	0.7	=	12.94	(74)
North	0.9x	0.77	x	7.24	x	24.19	x	0.63	x	0.7	=	53.52	(74)
North	0.9x	0.77	x	1.75	x	24.19	x	0.63	x	0.7	=	12.94	(74)
North	0.9x	0.77	x	1.75	x	13.12	x	0.63	x	0.7	=	7.02	(74)
North	0.9x	0.77	x	1.75	x	13.12	x	0.63	x	0.7	=	7.02	(74)
North	0.9x	0.77	x	7.24	x	13.12	x	0.63	x	0.7	=	29.02	(74)
North	0.9x	0.77	x	1.75	x	13.12	x	0.63	x	0.7	=	7.02	(74)
North	0.9x	0.77	x	1.75	x	8.86	x	0.63	x	0.7	=	4.74	(74)
North	0.9x	0.77	x	1.75	x	8.86	x	0.63	x	0.7	=	4.74	(74)

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North  $0.9 \times \boxed{0.77} \times \boxed{7.24} \times \boxed{8.86} \times \boxed{0.63} \times \boxed{0.7} = \boxed{19.61}$  (74)

North  $0.9 \times \boxed{0.77} \times \boxed{1.75} \times \boxed{8.86} \times \boxed{0.63} \times \boxed{0.7} = \boxed{4.74}$  (74)

Solar gains in watts, calculated for each month

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

(83)m=	40.59	77.57	131.81	211.71	285.2	305.31	285.05	226.15	158.47	92.33	50.07	33.84	(83)
--------	-------	-------	--------	--------	-------	--------	--------	--------	--------	-------	-------	-------	------

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

(84)m=	356.6	391.92	436.56	501.13	559.3	564.43	534.26	480.13	420.2	369.57	345.14	342	(84)
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### 7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.91	0.74	0.53	0.39	0.45	0.73	0.95	0.99	1	(86)

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

(87)m=	20.11	20.24	20.46	20.76	20.94	20.99	21	21	20.96	20.72	20.37	20.09	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.11	20.11	20.11	20.12	20.12	20.13	20.13	20.13	20.13	20.12	20.12	20.11	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.88	0.69	0.46	0.31	0.36	0.65	0.93	0.99	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.93	19.11	19.44	19.85	20.07	20.13	20.13	20.13	20.1	19.8	19.31	18.9	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	------	-------	------	------

fLA = Living area ÷ (4) =  (91)

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

(92)m=	19.52	19.68	19.95	20.31	20.51	20.56	20.57	20.57	20.53	20.26	19.84	19.5	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(93)m=	19.52	19.68	19.95	20.31	20.51	20.56	20.57	20.57	20.53	20.26	19.84	19.5	(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	0.99	0.96	0.89	0.71	0.49	0.35	0.41	0.69	0.93	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	353.83	386.38	421.27	444.56	397.04	278.59	186.64	195.33	290.27	343.72	339.63	339.86	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

(97)m=	740.28	716.64	650.7	544.8	419.67	280.88	186.89	195.9	304.34	460.36	610.04	736.12	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	287.52	221.94	170.69	72.17	16.84	0	0	0	0	86.78	194.7	294.81	
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Total per year (kWh/year) = Sum(98)...59...12 =  (98)

Space heating requirement in kWh/m<sup>2</sup>/year  (99)

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

**Space heating:**

Fraction of space heat from secondary/supplementary system  (201)

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Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement (calculated above)	287.52	221.94	170.69	72.17	16.84	0	0	0	0	86.78	194.7	294.81	kWh/year

(211)m = {[ (98)m x (204) ] } x 100 ÷ (206)			(211)											
	307.51	237.37	182.56	77.19	18.01	0	0	0	0	92.81	208.23	315.31		
	Total (kWh/year) = Sum(211) <sub>1..5,10...12</sub> =												1438.99	(211)

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

### Water heating

Output from water heater (calculated above)													
	167.86	148.15	156.04	140.51	138.15	124.1	119.81	130.61	130.11	145.67	153.24	164.04	

Efficiency of water heater		79.8	(216)										
(217)m =	86.24	85.89	85.05	83.14	80.84	79.8	79.8	79.8	79.8	83.48	85.45	86.36	(217)

Fuel for water heating, kWh/month														
(219)m = (64)m x 100 ÷ (217)m														
(219)m =	194.65	172.49	183.46	169.01	170.9	155.51	150.13	163.67	163.04	174.49	179.33	189.94		
	Total = Sum(219a) <sub>1..12</sub> =												2066.62	(219)

### Annual totals

	<b>kWh/year</b>	<b>kWh/year</b>
Space heating fuel used, main system 1	1438.99	
Water heating fuel used		2066.62

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		231.81	(232)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	=	0.216	=	310.82	(261)
Space heating (secondary)	(215) x	=	0.519	=	0	(263)
Water heating	(219) x	=	0.216	=	446.39	(264)
Space and water heating	(261) + (262) + (263) + (264) =				757.21	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	=	0.519	=	38.93	(267)
Electricity for lighting	(232) x	=	0.519	=	120.31	(268)

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Total CO2, kg/year

sum of (265)...(271) =

916.44

(272)

**TER =**

18.33

(273)



## DER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

Property Address: GT 108 - Be Lean

**Address :** GT 108, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	72.7	(1a) x	2.6	(2a) =	189.02 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	72.7	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	189.02 (5)

### 2. Ventilation rate:

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

#### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			2 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.1 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.09 (21)

Infiltration rate modified for monthly wind speed

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

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

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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# DER WorkSheet: New dwelling design stage

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

0.12	0.12	0.11	0.1	0.1	0.09	0.09	0.09	0.09	0.1	0.1	0.11
------	------	------	-----	-----	------	------	------	------	-----	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m= 

0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.2	0.21	0.22	0.22	0.23
------	------	------	------	------	------	------	-----	------	------	------	------

 (24a)

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

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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 (24b)

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

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

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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 (24d)

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

(25)m= 

0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.2	0.21	0.22	0.22	0.23
------	------	------	------	------	------	------	-----	------	------	------	------

 (25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			2.24	x1/[1/( 1.4)+ 0.04] =	2.97		(27)
Windows Type 2			2.24	x1/[1/( 1.4)+ 0.04] =	2.97		(27)
Windows Type 3			9.25	x1/[1/( 1.4)+ 0.04] =	12.26		(27)
Windows Type 4			2.24	x1/[1/( 1.4)+ 0.04] =	2.97		(27)
Walls	67.08	15.97	51.11	x 0.12 =	6.13		(29)
Total area of elements, m <sup>2</sup>			67.08				(31)
Party wall			28.21	x 0 =	0		(32)

\* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 27.31 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 7.79 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 35.09 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	14.69	14.54	14.4	13.68	13.53	12.81	12.81	12.67	13.1	13.53	13.82	14.11

 (38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	49.78	49.64	49.49	48.77	48.63	47.9	47.9	47.76	48.19	48.63	48.91	49.2
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Average = Sum(39)<sub>1...12</sub> /12= 48.73 (39)

# DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m<sup>2</sup>K

(40)m = (39)m ÷ (4)

(40)m=	0.68	0.68	0.68	0.67	0.67	0.66	0.66	0.66	0.66	0.67	0.67	0.68	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.67	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

**4. Water heating energy requirement: kWh/year:**

Assumed occupancy, N 2.31 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)<sup>2</sup>)] + 0.0013 x (TFA - 13.9)  
if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 89.06 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	97.96	94.4	90.84	87.28	83.72	80.15	80.15	83.72	87.28	90.84	94.4	97.96	(44)
Total = Sum(44) <sub>1...12</sub> =												1068.71	

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	145.28	127.06	131.12	114.31	109.68	94.65	87.71	100.64	101.85	118.69	129.56	140.69	(45)
Total = Sum(45) <sub>1...12</sub> =												1401.24	

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m= 21.79 19.06 19.67 17.15 16.45 14.2 13.16 15.1 15.28 17.8 19.43 21.1 (46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month (56)m = (55) x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

# DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	200.56	176.99	186.39	167.8	164.96	148.14	142.98	155.92	155.34	173.97	183.05	195.97	(62)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	200.56	176.99	186.39	167.8	164.96	148.14	142.98	155.92	155.34	173.97	183.05	195.97		
<b>Output from water heater (annual)<sub>1...12</sub></b>												2052.08	(64)	

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	92.53	82.19	87.82	80.8	80.69	74.27	73.38	77.69	76.66	83.69	85.87	91	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	115.49	115.49	115.49	115.49	115.49	115.49	115.49	115.49	115.49	115.49	115.49	115.49	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.14	16.11	13.11	9.92	7.42	6.26	6.77	8.79	11.8	14.99	17.49	18.65	(67)
--------	-------	-------	-------	------	------	------	------	------	------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	203.51	205.63	200.3	188.98	174.67	161.23	152.25	150.14	155.46	166.79	181.09	194.54	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	(69)
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Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	124.36	122.31	118.03	112.23	108.46	103.15	98.63	104.42	106.47	112.48	119.27	122.32	(72)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	403.67	401.7	389.09	368.77	348.19	328.29	315.3	321	331.38	351.91	375.5	393.15	(73)
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## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub>g</sub> Table 6b	FF Table 6c	Gains (W)							
North	0.9x	0.77	x	9.25	x	10.63	x	0.4	x	0.8	=	21.81	(74)
North	0.9x	0.77	x	2.24	x	10.63	x	0.4	x	0.8	=	5.28	(74)
North	0.9x	0.77	x	9.25	x	20.32	x	0.4	x	0.8	=	41.68	(74)
North	0.9x	0.77	x	2.24	x	20.32	x	0.4	x	0.8	=	10.09	(74)
North	0.9x	0.77	x	9.25	x	34.53	x	0.4	x	0.8	=	70.83	(74)

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North	0.9x	0.77	x	2.24	x	34.53	x	0.4	x	0.8	=	17.15	(74)
North	0.9x	0.77	x	9.25	x	55.46	x	0.4	x	0.8	=	113.77	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.4	x	0.8	=	27.55	(74)
North	0.9x	0.77	x	9.25	x	74.72	x	0.4	x	0.8	=	153.26	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.4	x	0.8	=	37.11	(74)
North	0.9x	0.77	x	9.25	x	79.99	x	0.4	x	0.8	=	164.07	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.4	x	0.8	=	39.73	(74)
North	0.9x	0.77	x	9.25	x	74.68	x	0.4	x	0.8	=	153.18	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.4	x	0.8	=	37.1	(74)
North	0.9x	0.77	x	9.25	x	59.25	x	0.4	x	0.8	=	121.53	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.4	x	0.8	=	29.43	(74)
North	0.9x	0.77	x	9.25	x	41.52	x	0.4	x	0.8	=	85.16	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.4	x	0.8	=	20.62	(74)
North	0.9x	0.77	x	9.25	x	24.19	x	0.4	x	0.8	=	49.62	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.4	x	0.8	=	12.02	(74)
North	0.9x	0.77	x	9.25	x	13.12	x	0.4	x	0.8	=	26.91	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.4	x	0.8	=	6.52	(74)
North	0.9x	0.77	x	9.25	x	8.86	x	0.4	x	0.8	=	18.18	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.4	x	0.8	=	4.4	(74)
East	0.9x	0.77	x	2.24	x	19.64	x	0.4	x	0.8	=	9.76	(76)
East	0.9x	0.77	x	2.24	x	19.64	x	0.4	x	0.8	=	9.76	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.4	x	0.8	=	19.09	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.4	x	0.8	=	19.09	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.4	x	0.8	=	31.43	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.4	x	0.8	=	31.43	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.4	x	0.8	=	45.84	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.4	x	0.8	=	45.84	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.4	x	0.8	=	56.18	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.4	x	0.8	=	56.18	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.4	x	0.8	=	57.51	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.4	x	0.8	=	57.51	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.4	x	0.8	=	54.75	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.4	x	0.8	=	54.75	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.4	x	0.8	=	47.03	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.4	x	0.8	=	47.03	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.4	x	0.8	=	36.55	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.4	x	0.8	=	36.55	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.4	x	0.8	=	22.65	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.4	x	0.8	=	22.65	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.4	x	0.8	=	12.16	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.4	x	0.8	=	12.16	(76)

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East  $0.9 \times \boxed{0.77} \times \boxed{2.24} \times \boxed{16.15} \times \boxed{0.4} \times \boxed{0.8} = \boxed{8.02}$  (76)

East  $0.9 \times \boxed{0.77} \times \boxed{2.24} \times \boxed{16.15} \times \boxed{0.4} \times \boxed{0.8} = \boxed{8.02}$  (76)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	46.61	89.95	150.84	233	302.73	318.82	299.78	245.02	178.89	106.93	57.75	38.63	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	450.28	491.64	539.94	601.78	650.93	647.11	615.08	566.02	510.28	458.84	433.26	431.78	(84)
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### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 

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 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.88	0.68	0.47	0.34	0.39	0.64	0.93	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.46	20.56	20.73	20.91	20.99	21	21	21	20.99	20.89	20.64	20.44	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.35	20.36	20.36	20.37	20.37	20.38	20.38	20.38	20.37	20.37	20.36	20.36	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.96	0.85	0.64	0.43	0.29	0.34	0.59	0.9	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.63	19.77	20.01	20.27	20.36	20.38	20.38	20.38	20.37	20.24	19.91	19.61	(90)
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fLA = Living area ÷ (4) = 

0.33
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 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.9	20.03	20.25	20.48	20.56	20.58	20.58	20.58	20.57	20.45	20.15	19.88	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.9	20.03	20.25	20.48	20.56	20.58	20.58	20.58	20.57	20.45	20.15	19.88	(93)
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### 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.96	0.86	0.65	0.44	0.31	0.35	0.61	0.91	0.98	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	447.5	485.21	518.82	516.06	425.35	286.27	190.7	199.72	309.6	415.76	426.47	429.76	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m ]

(97)m=	776.59	751.07	680.38	564.81	431.05	286.5	190.71	199.75	312.02	479.11	638.21	771.44	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	244.84	178.66	120.2	35.1	4.24	0	0	0	0	47.13	152.45	254.21	(98)
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Total per year (kWh/year) = Sum(98)...5,9...12 = 

1036.84
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 (98)

Space heating requirement in kWh/m<sup>2</sup>/year

14.26
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 (99)

### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

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Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)
<i>The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.</i>			
Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.1	(306)
<b>Space heating</b>		<b>kWh/year</b>	
Annual space heating requirement		1036.84	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1140.52	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308)
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
<b>Water heating</b>			
Annual water heating requirement		2052.08	
If DHW from community scheme:			
Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2257.29	(310a)
Electricity used for heat distribution	0.01 x [(307a)...(307e) + (310a)...(310e)] =	33.98	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		152.78	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	152.78	(331)
Energy for lighting (calculated in Appendix L)		320.42	(332)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)				
Efficiency of heat source 1 (%)	<i>If there is CHP using two fuels repeat (363) to (366) for the second fuel</i>			95
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	772.56
Electrical energy for heat distribution	[(313) x	0.52	=	17.63
Total CO2 associated with community systems	(363)...(366) + (368)...(372)		=	790.19
CO2 associated with space heating (secondary)	(309) x	0	=	0
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0
Total CO2 associated with space and water heating	(373) + (374) + (375) =			790.19
CO2 associated with electricity for pumps and fans within dwelling	(331) x	0.52	=	79.29

## DER WorkSheet: New dwelling design stage

CO2 associated with electricity for lighting	(332)) x	0.52	=	166.3	(379)
<b>Total CO2, kg/year</b>	sum of (376)...(382) =			1035.78	(383)
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =			14.25	(384)
<b>EI rating (section 14)</b>				88.21	(385)



## TER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

### Property Address: GT 108 - Be Lean

**Address :** GT 108, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	72.7	(1a) x	2.6	(2a) =	189.02
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	72.7	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	189.02

### 2. Ventilation rate:

	main heating		secondary heating		other		total		m <sup>3</sup> per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0
Number of open flues	0	+	0	+	0	=	0	x 20 =	0
Number of intermittent fans							3	x 10 =	30
Number of passive vents							0	x 10 =	0
Number of flueless gas fires							0	x 40 =	0

### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.16	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.41	(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>				
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.38	(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
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.48	0.47	0.46	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.44
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0.62	0.61	0.61	0.59	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.6
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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 

0.62	0.61	0.61	0.59	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.6
------	------	------	------	------	------	------	------	------	------	------	-----

 (25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			2.24	$x1/[1/(1.4)+0.04] =$	2.97		(27)
Windows Type 2			2.24	$x1/[1/(1.4)+0.04] =$	2.97		(27)
Windows Type 3			9.25	$x1/[1/(1.4)+0.04] =$	12.26		(27)
Windows Type 4			2.24	$x1/[1/(1.4)+0.04] =$	2.97		(27)
Walls	67.08	15.97	51.11	x 0.18 =	9.2		(29)
Total area of elements, m <sup>2</sup>			67.08				(31)
Party wall			28.21	x 0 =	0		(32)

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[(1/U\text{-value})+0.04]$  as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 30.37 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.92 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 36.29 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m= 

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
38.43	38.15	37.88	36.58	36.34	35.21	35.21	35	35.65	36.34	36.83	37.34

 (38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 

74.72	74.44	74.17	72.87	72.63	71.5	71.5	71.29	71.93	72.63	73.12	73.63
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Average = Sum(39)<sub>1...12</sub> /12= 72.87 (39)

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Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1.03	1.02	1.02	1	1	0.98	0.98	0.98	0.99	1	1.01	1.01	
Average = Sum(40) <sub>1...12</sub> / 12 =												1	(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 2.31 (42)  
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)  
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 89.06 (43)  
 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	97.96	94.4	90.84	87.28	83.72	80.15	80.15	83.72	87.28	90.84	94.4	97.96	
Total = Sum(44) <sub>1...12</sub> =												1068.71	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	145.28	127.06	131.12	114.31	109.68	94.65	87.71	100.64	101.85	118.69	129.56	140.69	
Total = Sum(45) <sub>1...12</sub> =												1401.24	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	21.79	19.06	19.67	17.15	16.45	14.2	13.16	15.1	15.28	17.8	19.43	21.1	(46)

Water storage loss:  
 Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (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) 0.75 (55)

Water storage loss calculated for each month (56)m = (55) x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m  
 (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	191.87	169.15	177.71	159.4	156.28	139.74	134.3	147.24	146.94	165.29	174.65	187.29	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	191.87	169.15	177.71	159.4	156.28	139.74	134.3	147.24	146.94	165.29	174.65	187.29	Output from water heater (annual) <sup>1...12</sup>		1949.86 (64)
--------	--------	--------	--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	---	--	--------------

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	85.58	75.92	80.87	74.08	73.75	67.54	66.44	70.74	69.94	76.74	79.15	84.06	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	115.49	115.49	115.49	115.49	115.49	115.49	115.49	115.49	115.49	115.49	115.49	115.49	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.15	16.12	13.11	9.93	7.42	6.26	6.77	8.8	11.81	14.99	17.5	18.66	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	203.51	205.63	200.3	188.98	174.67	161.23	152.25	150.14	155.46	166.79	181.09	194.54	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	(69)
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Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	(71)
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Water heating gains (Table 5)

(72)m=	115.03	112.97	108.7	102.89	99.12	93.81	89.3	95.08	97.14	103.15	109.93	112.98	(72)
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**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	397.34	395.37	382.76	362.44	341.86	321.96	308.97	314.67	325.05	345.58	369.18	386.82	(73)
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## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	x	Area m <sup>2</sup>	x	Flux Table 6a	x	g <sub>g</sub> Table 6b	x	FF Table 6c	=	Gains (W)			
North	0.9x		0.77	x	9.25	x	10.63	x	0.63	x	0.7	=	30.06	(74)
North	0.9x		0.77	x	2.24	x	10.63	x	0.63	x	0.7	=	7.28	(74)
North	0.9x		0.77	x	9.25	x	20.32	x	0.63	x	0.7	=	57.45	(74)
North	0.9x		0.77	x	2.24	x	20.32	x	0.63	x	0.7	=	13.91	(74)
North	0.9x		0.77	x	9.25	x	34.53	x	0.63	x	0.7	=	97.61	(74)

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North	0.9x	0.77	x	2.24	x	34.53	x	0.63	x	0.7	=	23.64	(74)
North	0.9x	0.77	x	9.25	x	55.46	x	0.63	x	0.7	=	156.79	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.63	x	0.7	=	37.97	(74)
North	0.9x	0.77	x	9.25	x	74.72	x	0.63	x	0.7	=	211.22	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.63	x	0.7	=	51.15	(74)
North	0.9x	0.77	x	9.25	x	79.99	x	0.63	x	0.7	=	226.11	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.63	x	0.7	=	54.76	(74)
North	0.9x	0.77	x	9.25	x	74.68	x	0.63	x	0.7	=	211.1	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.63	x	0.7	=	51.12	(74)
North	0.9x	0.77	x	9.25	x	59.25	x	0.63	x	0.7	=	167.48	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.63	x	0.7	=	40.56	(74)
North	0.9x	0.77	x	9.25	x	41.52	x	0.63	x	0.7	=	117.36	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.63	x	0.7	=	28.42	(74)
North	0.9x	0.77	x	9.25	x	24.19	x	0.63	x	0.7	=	68.38	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.63	x	0.7	=	16.56	(74)
North	0.9x	0.77	x	9.25	x	13.12	x	0.63	x	0.7	=	37.08	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.63	x	0.7	=	8.98	(74)
North	0.9x	0.77	x	9.25	x	8.86	x	0.63	x	0.7	=	25.06	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.63	x	0.7	=	6.07	(74)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)

## TER WorkSheet: New dwelling design stage

East  $0.9x$ 

0.77
------

 $\times$ 

2.24
------

 $\times$ 

16.15
-------

 $\times$ 

0.63
------

 $\times$ 

0.7
-----

 = 

11.06
-------

 (76)

East  $0.9x$ 

0.77
------

 $\times$ 

2.24
------

 $\times$ 

16.15
-------

 $\times$ 

0.63
------

 $\times$ 

0.7
-----

 = 

11.06
-------

 (76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m ... (82)m

(83)m=	64.23	123.96	207.88	321.11	417.2	439.37	413.13	337.67	246.54	147.36	79.59	53.24	(83)
--------	-------	--------	--------	--------	-------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	461.57	519.33	590.65	683.55	759.07	761.33	722.1	652.34	571.59	492.94	448.77	440.06	(84)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 

21
----

 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	1	0.99	0.98	0.93	0.8	0.59	0.43	0.5	0.78	0.97	0.99	1	

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.96	20.1	20.35	20.68	20.9	20.99	21	21	20.94	20.63	20.24	19.94	(87)
--------	-------	------	-------	-------	------	-------	----	----	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.06	20.06	20.07	20.08	20.08	20.1	20.1	20.1	20.09	20.08	20.08	20.07	(88)
--------	-------	-------	-------	-------	-------	------	------	------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.91	0.74	0.51	0.35	0.4	0.71	0.95	0.99	1	(89)
--------	---	------	------	------	------	------	------	-----	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.67	18.88	19.24	19.71	20	20.09	20.1	20.1	20.04	19.66	19.1	18.66	(90)
--------	-------	-------	-------	-------	----	-------	------	------	-------	-------	------	-------	------

fLA = Living area ÷ (4) = 

0.33
------

 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.09	19.28	19.6	20.03	20.29	20.38	20.39	20.39	20.34	19.98	19.47	19.08	(92)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.09	19.28	19.6	20.03	20.29	20.38	20.39	20.39	20.34	19.98	19.47	19.08	(93)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

### 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.97	0.91	0.76	0.54	0.37	0.43	0.73	0.95	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	459.37	514.35	575.34	622.83	573.48	407.55	270.46	283.17	418.15	467.96	444.27	438.42	(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=	1105.38	1070.16	971.5	810.8	624.13	413.44	271.09	284.57	448.54	680.9	904.77	1095.44	(97)
--------	---------	---------	-------	-------	--------	--------	--------	--------	--------	-------	--------	---------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	480.63	373.51	294.75	135.34	37.69	0	0	0	0	158.42	331.56	488.83	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = Sum(98)...59...12 = 

2300.72
---------

 (98)

Space heating requirement in kWh/m<sup>2</sup>/year 

31.65
-------

 (99)

### 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

Fraction of space heat from secondary/supplementary system 

0
---

 (201)

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Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement (calculated above)													kWh/year	
	480.63	373.51	294.75	135.34	37.69	0	0	0	0	158.42	331.56	488.83		
(211)m = {[ (98)m x (204)] } x 100 ÷ (206)													(211)	
	514.05	399.47	315.24	144.75	40.31	0	0	0	0	169.44	354.61	522.81		
	Total (kWh/year) = Sum(211) <sub>1..5,10..12</sub> =												2460.67	(211)

Space heating fuel (secondary), kWh/month	= {[ (98)m x (201)] } x 100 ÷ (208)				
(215)m =	0	0	0		
	0	0	0		
	0	0	0		
	0	0	0		
	0	0	0		
	0	0	0		
	0	0	0		
	0	0	0		
	Total (kWh/year) = Sum(215) <sub>1..5,10..12</sub> =			0	(215)

### Water heating

Output from water heater (calculated above)														
	191.87	169.15	177.71											
	159.4	156.28	139.74											
	134.3	147.24	146.94											
	165.29	174.65	187.29											
Efficiency of water heater				79.8	(216)									
(217)m =	87.17	86.87	86.15	84.38	81.68	79.8	79.8	79.8	79.8	84.7	86.5	87.26	(217)	
Fuel for water heating, kWh/month														
(219)m = (64)m x 100 ÷ (217)m														
(219)m =	220.13	194.72	206.27	188.91	191.34	175.11	168.3	184.51	184.13	195.14	201.91	214.64		
	Total = Sum(219a) <sub>1..12</sub> =												2325.1	(219)

### Annual totals

	<b>kWh/year</b>	<b>kWh/year</b>	
Space heating fuel used, main system 1		2460.67	
Water heating fuel used		2325.1	
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		320.55	(232)

### 12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	=	0.216	=	531.5
Space heating (secondary)	(215) x	=	0.519	=	0
Water heating	(219) x	=	0.216	=	502.22
Space and water heating	(261) + (262) + (263) + (264) =				1033.73
Electricity for pumps, fans and electric keep-hot	(231) x	=	0.519	=	38.93
Electricity for lighting	(232) x	=	0.519	=	166.36

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Total CO2, kg/year

sum of (265)...(271) =

1239.01

(272)

**TER =**

17.04

(273)



## DER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

Property Address: GT 303 - Be Lean

**Address :** GT 303, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	90.4	(1a) x	2.6	(2a) =	235.04 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.4	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	235.04 (5)

### 2. Ventilation rate:

	main heating		secondary heating		other		total			m <sup>3</sup> per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

#### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			2	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.1	(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.08	(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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# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1
------	------	-----	------	------	------	------	------	------	------	-----	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (25)

**3. Heat losses and heat loss parameter:**

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			9.25	$\times 1/[1/(1.4)+0.04] =$	12.26		(27)
Windows Type 2			1.5	$\times 1/[1/(1.4)+0.04] =$	1.99		(27)
Windows Type 3			4.01	$\times 1/[1/(1.4)+0.04] =$	5.32		(27)
Windows Type 4			3.95	$\times 1/[1/(1.4)+0.04] =$	5.24		(27)
Windows Type 5			2.24	$\times 1/[1/(1.4)+0.04] =$	2.97		(27)
Windows Type 6			1.5	$\times 1/[1/(1.4)+0.04] =$	1.99		(27)
Windows Type 7			1.5	$\times 1/[1/(1.4)+0.04] =$	1.99		(27)
Walls	54.86	23.95	30.91	$\times 0.12 =$	3.71		(29)
Roof	14.8	0	14.8	$\times 0.1 =$	1.48		(30)
Total area of elements, m <sup>2</sup>			69.66				(31)
Party wall			54.86	$\times 0 =$	0		(32)

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[1/(U\text{-value})+0.04]$  as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 36.94 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 9.48 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.42 (37)

# DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly

$$(38)m = 0.33 \times (25)m \times (5)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	17.52	17.35	17.19	16.37	16.2	15.38	15.38	15.21	15.71	16.2	16.53	16.86	(38)

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

(39)m=	63.94	63.78	63.61	62.79	62.62	61.8	61.8	61.63	62.13	62.62	62.95	63.28	
Average = Sum(39) <sub>1...12</sub> / 12 =												62.75	(39)

Heat loss parameter (HLP), W/m<sup>2</sup>K

$$(40)m = (39)m \div (4)$$

(40)m=	0.71	0.71	0.7	0.69	0.69	0.68	0.68	0.68	0.69	0.69	0.7	0.7	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.69	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

## 4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.63

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)<sup>2</sup>)] + 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

96.69

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	106.36	102.49	98.62	94.76	90.89	87.02	87.02	90.89	94.76	98.62	102.49	106.36	
Total = Sum(44) <sub>1...12</sub> =												1160.28	(44)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

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=	157.73	137.95	142.35	124.11	119.08	102.76	95.22	109.27	110.57	128.86	140.66	152.75	
Total = Sum(45) <sub>1...12</sub> =												1521.31	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	23.66	20.69	21.35	18.62	17.86	15.41	14.28	16.39	16.59	19.33	21.1	22.91	(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

110

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0.02

(51)

If community heating see section 4.3

Volume factor from Table 2a

1.03

(52)

Temperature factor from Table 2b

0.6

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

1.03

(54)

Enter (50) or (54) in (55)

1.03

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

# DER WorkSheet: New dwelling design stage

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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	213	187.88	197.63	177.6	174.36	156.25	150.5	164.54	164.07	184.14	194.16	208.03	(62)
--------	-----	--------	--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	213	187.88	197.63	177.6	174.36	156.25	150.5	164.54	164.07	184.14	194.16	208.03	
Output from water heater (annual) <sub>1...12</sub>												2172.15	(64)

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	96.67	85.81	91.55	84.06	83.82	76.96	75.88	80.55	79.56	87.07	89.57	95.01	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	131.56	131.56	131.56	131.56	131.56	131.56	131.56	131.56	131.56	131.56	131.56	131.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.38	18.99	15.44	11.69	8.74	7.38	7.97	10.36	13.91	17.66	20.61	21.97	(67)
--------	-------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	239.81	242.3	236.03	222.68	205.83	189.99	179.41	176.92	183.19	196.54	213.39	229.23	(68)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-105.25	-105.25	-105.25	-105.25	-105.25	-105.25	-105.25	-105.25	-105.25	-105.25	-105.25	-105.25	(71)
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

(72)m=	129.93	127.69	123.06	116.75	112.66	106.89	101.99	108.27	110.5	117.03	124.4	127.7	(72)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	-------	-------	------

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	453.59	451.45	436.99	413.59	389.69	366.73	351.84	358.02	370.07	393.69	420.87	441.37	(73)
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## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
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## DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	9.25	x	19.64	x	0.4	x	0.8	=	40.29	(76)
East	0.9x	0.77	x	1.5	x	19.64	x	0.4	x	0.8	=	6.53	(76)
East	0.9x	0.77	x	4.01	x	19.64	x	0.4	x	0.8	=	17.47	(76)
East	0.9x	0.77	x	1.5	x	19.64	x	0.4	x	0.8	=	6.53	(76)
East	0.9x	0.77	x	9.25	x	38.42	x	0.4	x	0.8	=	78.81	(76)
East	0.9x	0.77	x	1.5	x	38.42	x	0.4	x	0.8	=	12.78	(76)
East	0.9x	0.77	x	4.01	x	38.42	x	0.4	x	0.8	=	34.17	(76)
East	0.9x	0.77	x	1.5	x	38.42	x	0.4	x	0.8	=	12.78	(76)
East	0.9x	0.77	x	9.25	x	63.27	x	0.4	x	0.8	=	129.79	(76)
East	0.9x	0.77	x	1.5	x	63.27	x	0.4	x	0.8	=	21.05	(76)
East	0.9x	0.77	x	4.01	x	63.27	x	0.4	x	0.8	=	56.27	(76)
East	0.9x	0.77	x	1.5	x	63.27	x	0.4	x	0.8	=	21.05	(76)
East	0.9x	0.77	x	9.25	x	92.28	x	0.4	x	0.8	=	189.29	(76)
East	0.9x	0.77	x	1.5	x	92.28	x	0.4	x	0.8	=	30.7	(76)
East	0.9x	0.77	x	4.01	x	92.28	x	0.4	x	0.8	=	82.06	(76)
East	0.9x	0.77	x	1.5	x	92.28	x	0.4	x	0.8	=	30.7	(76)
East	0.9x	0.77	x	9.25	x	113.09	x	0.4	x	0.8	=	231.98	(76)
East	0.9x	0.77	x	1.5	x	113.09	x	0.4	x	0.8	=	37.62	(76)
East	0.9x	0.77	x	4.01	x	113.09	x	0.4	x	0.8	=	100.57	(76)
East	0.9x	0.77	x	1.5	x	113.09	x	0.4	x	0.8	=	37.62	(76)
East	0.9x	0.77	x	9.25	x	115.77	x	0.4	x	0.8	=	237.48	(76)
East	0.9x	0.77	x	1.5	x	115.77	x	0.4	x	0.8	=	38.51	(76)
East	0.9x	0.77	x	4.01	x	115.77	x	0.4	x	0.8	=	102.95	(76)
East	0.9x	0.77	x	1.5	x	115.77	x	0.4	x	0.8	=	38.51	(76)
East	0.9x	0.77	x	9.25	x	110.22	x	0.4	x	0.8	=	226.09	(76)
East	0.9x	0.77	x	1.5	x	110.22	x	0.4	x	0.8	=	36.66	(76)
East	0.9x	0.77	x	4.01	x	110.22	x	0.4	x	0.8	=	98.01	(76)
East	0.9x	0.77	x	1.5	x	110.22	x	0.4	x	0.8	=	36.66	(76)
East	0.9x	0.77	x	9.25	x	94.68	x	0.4	x	0.8	=	194.21	(76)
East	0.9x	0.77	x	1.5	x	94.68	x	0.4	x	0.8	=	31.49	(76)
East	0.9x	0.77	x	4.01	x	94.68	x	0.4	x	0.8	=	84.19	(76)
East	0.9x	0.77	x	1.5	x	94.68	x	0.4	x	0.8	=	31.49	(76)
East	0.9x	0.77	x	9.25	x	73.59	x	0.4	x	0.8	=	150.95	(76)
East	0.9x	0.77	x	1.5	x	73.59	x	0.4	x	0.8	=	24.48	(76)
East	0.9x	0.77	x	4.01	x	73.59	x	0.4	x	0.8	=	65.44	(76)
East	0.9x	0.77	x	1.5	x	73.59	x	0.4	x	0.8	=	24.48	(76)
East	0.9x	0.77	x	9.25	x	45.59	x	0.4	x	0.8	=	93.52	(76)
East	0.9x	0.77	x	1.5	x	45.59	x	0.4	x	0.8	=	15.16	(76)
East	0.9x	0.77	x	4.01	x	45.59	x	0.4	x	0.8	=	40.54	(76)
East	0.9x	0.77	x	1.5	x	45.59	x	0.4	x	0.8	=	15.16	(76)
East	0.9x	0.77	x	9.25	x	24.49	x	0.4	x	0.8	=	50.23	(76)

## DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	1.5	x	24.49	x	0.4	x	0.8	=	8.15	(76)
East	0.9x	0.77	x	4.01	x	24.49	x	0.4	x	0.8	=	21.78	(76)
East	0.9x	0.77	x	1.5	x	24.49	x	0.4	x	0.8	=	8.15	(76)
East	0.9x	0.77	x	9.25	x	16.15	x	0.4	x	0.8	=	33.13	(76)
East	0.9x	0.77	x	1.5	x	16.15	x	0.4	x	0.8	=	5.37	(76)
East	0.9x	0.77	x	4.01	x	16.15	x	0.4	x	0.8	=	14.36	(76)
East	0.9x	0.77	x	1.5	x	16.15	x	0.4	x	0.8	=	5.37	(76)
South	0.9x	0.77	x	3.95	x	46.75	x	0.4	x	0.8	=	40.95	(78)
South	0.9x	0.77	x	2.24	x	46.75	x	0.4	x	0.8	=	23.22	(78)
South	0.9x	0.77	x	1.5	x	46.75	x	0.4	x	0.8	=	15.55	(78)
South	0.9x	0.77	x	3.95	x	76.57	x	0.4	x	0.8	=	67.07	(78)
South	0.9x	0.77	x	2.24	x	76.57	x	0.4	x	0.8	=	38.03	(78)
South	0.9x	0.77	x	1.5	x	76.57	x	0.4	x	0.8	=	25.47	(78)
South	0.9x	0.77	x	3.95	x	97.53	x	0.4	x	0.8	=	85.43	(78)
South	0.9x	0.77	x	2.24	x	97.53	x	0.4	x	0.8	=	48.45	(78)
South	0.9x	0.77	x	1.5	x	97.53	x	0.4	x	0.8	=	32.44	(78)
South	0.9x	0.77	x	3.95	x	110.23	x	0.4	x	0.8	=	96.56	(78)
South	0.9x	0.77	x	2.24	x	110.23	x	0.4	x	0.8	=	54.76	(78)
South	0.9x	0.77	x	1.5	x	110.23	x	0.4	x	0.8	=	36.67	(78)
South	0.9x	0.77	x	3.95	x	114.87	x	0.4	x	0.8	=	100.62	(78)
South	0.9x	0.77	x	2.24	x	114.87	x	0.4	x	0.8	=	57.06	(78)
South	0.9x	0.77	x	1.5	x	114.87	x	0.4	x	0.8	=	38.21	(78)
South	0.9x	0.77	x	3.95	x	110.55	x	0.4	x	0.8	=	96.83	(78)
South	0.9x	0.77	x	2.24	x	110.55	x	0.4	x	0.8	=	54.91	(78)
South	0.9x	0.77	x	1.5	x	110.55	x	0.4	x	0.8	=	36.77	(78)
South	0.9x	0.77	x	3.95	x	108.01	x	0.4	x	0.8	=	94.61	(78)
South	0.9x	0.77	x	2.24	x	108.01	x	0.4	x	0.8	=	53.65	(78)
South	0.9x	0.77	x	1.5	x	108.01	x	0.4	x	0.8	=	35.93	(78)
South	0.9x	0.77	x	3.95	x	104.89	x	0.4	x	0.8	=	91.88	(78)
South	0.9x	0.77	x	2.24	x	104.89	x	0.4	x	0.8	=	52.11	(78)
South	0.9x	0.77	x	1.5	x	104.89	x	0.4	x	0.8	=	34.89	(78)
South	0.9x	0.77	x	3.95	x	101.89	x	0.4	x	0.8	=	89.25	(78)
South	0.9x	0.77	x	2.24	x	101.89	x	0.4	x	0.8	=	50.61	(78)
South	0.9x	0.77	x	1.5	x	101.89	x	0.4	x	0.8	=	33.89	(78)
South	0.9x	0.77	x	3.95	x	82.59	x	0.4	x	0.8	=	72.34	(78)
South	0.9x	0.77	x	2.24	x	82.59	x	0.4	x	0.8	=	41.02	(78)
South	0.9x	0.77	x	1.5	x	82.59	x	0.4	x	0.8	=	27.47	(78)
South	0.9x	0.77	x	3.95	x	55.42	x	0.4	x	0.8	=	48.54	(78)
South	0.9x	0.77	x	2.24	x	55.42	x	0.4	x	0.8	=	27.53	(78)
South	0.9x	0.77	x	1.5	x	55.42	x	0.4	x	0.8	=	18.43	(78)
South	0.9x	0.77	x	3.95	x	40.4	x	0.4	x	0.8	=	35.39	(78)

## DER WorkSheet: New dwelling design stage

South  $0.9 \times \boxed{0.77} \times \boxed{2.24} \times \boxed{40.4} \times \boxed{0.4} \times \boxed{0.8} = \boxed{20.07}$  (78)

South  $0.9 \times \boxed{0.77} \times \boxed{1.5} \times \boxed{40.4} \times \boxed{0.4} \times \boxed{0.8} = \boxed{13.44}$  (78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 

150.55	269.11	394.48	520.73	603.69	605.97	581.62	520.26	439.1	305.22	182.81	127.13
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 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 

604.13	720.56	831.47	934.32	993.38	972.69	933.46	878.28	809.17	698.92	603.68	568.5
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 (84)

### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 

21
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 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

(86)m= 

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.99	0.98	0.92	0.78	0.58	0.41	0.29	0.32	0.53	0.85	0.98	1

 (86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 

20.47	20.64	20.83	20.96	21	21	21	21	21	20.94	20.68	20.44
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 (87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m= 

20.33	20.34	20.34	20.35	20.35	20.36	20.36	20.36	20.35	20.35	20.34	20.34
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m= 

0.99	0.97	0.91	0.74	0.54	0.37	0.25	0.28	0.48	0.82	0.98	0.99
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 (89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m= 

19.63	19.87	20.13	20.3	20.34	20.36	20.36	20.36	20.35	20.28	19.94	19.59
-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------

 (90)

fLA = Living area ÷ (4) = 

0.33
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 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m= 

19.9	20.12	20.36	20.52	20.56	20.56	20.56	20.57	20.56	20.49	20.18	19.86
------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m= 

19.9	20.12	20.36	20.52	20.56	20.56	20.56	20.57	20.56	20.49	20.18	19.86
------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (93)

### 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m= 

0.99	0.97	0.91	0.75	0.56	0.38	0.26	0.29	0.5	0.83	0.97	0.99
------	------	------	------	------	------	------	------	-----	------	------	------

 (94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m= 

598.65	699.38	754.55	702.29	551.75	368.49	245.02	256.76	400.54	576.65	587.57	564.95
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 (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
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 (96)

Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m ]

(97)m= 

997.71	970.48	881.36	729.46	554.55	368.61	245.03	256.77	401.44	619.62	823.34	991.15
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m= 

296.9	182.18	94.34	19.56	2.08	0	0	0	0	31.97	169.76	317.09
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 (98)

Total per year (kWh/year) = Sum(98) ... 5,9...12 = 

1113.88
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 (98)

Space heating requirement in kWh/m<sup>2</sup>/year

12.32
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 (99)

### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

## DER WorkSheet: New dwelling design stage

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)
<i>The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.</i>		
Fraction of heat from Community boilers	1	(303a)
Fraction of total space heat from Community boilers <span style="float: right;">(302) x (303a) =</span>	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system	1	(305)
Distribution loss factor (Table 12c) for community heating system	1.1	(306)
<b>Space heating</b>		
<b>kWh/year</b>		
Annual space heating requirement	1113.88	
Space heat from Community boilers <span style="float: right;">(98) x (304a) x (305) x (306) =</span>	1225.27	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0	(308)
Space heating requirement from secondary/supplementary system <span style="float: right;">(98) x (301) x 100 ÷ (308) =</span>	0	(309)
<b>Water heating</b>		
Annual water heating requirement	2172.15	
If DHW from community scheme: Water heat from Community boilers <span style="float: right;">(64) x (303a) x (305) x (306) =</span>	2389.36	(310a)
Electricity used for heat distribution <span style="float: right;">0.01 x [(307a)...(307e) + (310a)...(310e)] =</span>	36.15	(313)
Cooling System Energy Efficiency Ratio	0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0) <span style="float: right;">= (107) ÷ (314) =</span>	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	189.97	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year <span style="float: right;">=(330a) + (330b) + (330g) =</span>	189.97	(331)
Energy for lighting (calculated in Appendix L)	377.57	(332)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)				
Efficiency of heat source 1 (%) <span style="float: right;"><i>If there is CHP using two fuels repeat (363) to (366) for the second fuel</i></span>			95	(367a)
CO2 associated with heat source 1 <span style="float: right;">[(307b)+(310b)] x 100 ÷ (367b) x</span>		0.22	=	821.85 (367)
Electrical energy for heat distribution <span style="float: right;">[(313) x</span>		0.52	=	18.76 (372)
Total CO2 associated with community systems <span style="float: right;">(363)...(366) + (368)...(372)</span>			=	840.61 (373)
CO2 associated with space heating (secondary) <span style="float: right;">(309) x</span>		0	=	0 (374)
CO2 associated with water from immersion heater or instantaneous heater <span style="float: right;">(312) x</span>		0.22	=	0 (375)
Total CO2 associated with space and water heating <span style="float: right;">(373) + (374) + (375) =</span>				840.61 (376)
CO2 associated with electricity for pumps and fans within dwelling <span style="float: right;">(331) x</span>		0.52	=	98.59 (378)



## DER WorkSheet: New dwelling design stage

CO2 associated with electricity for lighting	(332)) x	0.52	=	195.96	(379)
<b>Total CO2, kg/year</b>	sum of (376)...(382) =			1135.16	(383)
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =			12.56	(384)
<b>EI rating (section 14)</b>				88.77	(385)

# TER WorkSheet: New dwelling design stage

## User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

## Property Address: GT 303 - Be Lean

**Address :** GT 303, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	90.4	(1a) ×	2.6	(2a) =	235.04 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.4	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	235.04 (5)

### 2. Ventilation rate:

	main heating		secondary heating		other		total		m <sup>3</sup> per hour
Number of chimneys	0	+	0	+	0	=	0	× 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	× 20 =	0 (6b)
Number of intermittent fans							3	× 10 =	30 (7a)
Number of passive vents							0	× 10 =	0 (7b)
Number of flueless gas fires							0	× 40 =	0 (7c)

#### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.13 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]×0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 × (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.38 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 × (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) × (20) =		0.32 (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
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.41	0.4	0.39	0.35	0.35	0.3	0.3	0.3	0.32	0.35	0.36	0.38
------	-----	------	------	------	-----	-----	-----	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:  (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)  (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =  (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.57	0.57
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(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 

0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.57	0.57
------	------	------	------	------	------	------	------	------	------	------	------

(25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			<input type="text" value="8.73"/>	$\times 1/[1/(1.4)+0.04] =$	<input type="text" value="11.57"/>		(27)
Windows Type 2			<input type="text" value="1.42"/>	$\times 1/[1/(1.4)+0.04] =$	<input type="text" value="1.88"/>		(27)
Windows Type 3			<input type="text" value="3.78"/>	$\times 1/[1/(1.4)+0.04] =$	<input type="text" value="5.01"/>		(27)
Windows Type 4			<input type="text" value="3.73"/>	$\times 1/[1/(1.4)+0.04] =$	<input type="text" value="4.95"/>		(27)
Windows Type 5			<input type="text" value="2.11"/>	$\times 1/[1/(1.4)+0.04] =$	<input type="text" value="2.8"/>		(27)
Windows Type 6			<input type="text" value="1.42"/>	$\times 1/[1/(1.4)+0.04] =$	<input type="text" value="1.88"/>		(27)
Windows Type 7			<input type="text" value="1.42"/>	$\times 1/[1/(1.4)+0.04] =$	<input type="text" value="1.88"/>		(27)
Walls	<input type="text" value="54.86"/>	<input type="text" value="22.61"/>	<input type="text" value="32.25"/>	$\times$ <input type="text" value="0.18"/>	$=$ <input type="text" value="5.81"/>		(29)
Roof	<input type="text" value="14.8"/>	<input type="text" value="0"/>	<input type="text" value="14.8"/>	$\times$ <input type="text" value="0.13"/>	$=$ <input type="text" value="1.92"/>		(30)
Total area of elements, m <sup>2</sup>			<input type="text" value="69.66"/>				(31)
Party wall			<input type="text" value="54.86"/>	$\times$ <input type="text" value="0"/>	$=$ <input type="text" value="0"/>		(32)

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[1/(U\text{-value})+0.04]$  as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) =  (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) =  (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium  (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  (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) =  (37)

## TER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly

$$(38)m = 0.33 \times (25)m \times (5)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	45.28	45.03	44.78	43.62	43.4	42.39	42.39	42.2	42.78	43.4	43.84	44.3	(38)

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

(39)m=	89.27	89.02	88.77	87.61	87.4	86.38	86.38	86.2	86.77	87.4	87.84	88.3	
Average = Sum(39) <sub>1...12</sub> / 12 =												87.61	(39)

Heat loss parameter (HLP), W/m<sup>2</sup>K

$$(40)m = (39)m \div (4)$$

(40)m=	0.99	0.98	0.98	0.97	0.97	0.96	0.96	0.95	0.96	0.97	0.97	0.98	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.97	(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

2.63

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)<sup>2</sup>)] + 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

96.69

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	106.36	102.49	98.62	94.76	90.89	87.02	87.02	90.89	94.76	98.62	102.49	106.36	
Total = Sum(44) <sub>1...12</sub> =												1160.28	(44)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

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=	157.73	137.95	142.35	124.11	119.08	102.76	95.22	109.27	110.57	128.86	140.66	152.75	
Total = Sum(45) <sub>1...12</sub> =												1521.31	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	23.66	20.69	21.35	18.62	17.86	15.41	14.28	16.39	16.59	19.33	21.1	22.91	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (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) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) x (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)
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# TER WorkSheet: New dwelling design stage

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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	204.32	180.03	188.95	169.2	165.68	147.85	141.82	155.86	155.66	175.46	185.75	199.35	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	204.32	180.03	188.95	169.2	165.68	147.85	141.82	155.86	155.66	175.46	185.75	199.35	
Output from water heater (annual) <sup>1...12</sup>												2069.93 (64)	

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	89.72	79.54	84.61	77.34	76.87	70.24	68.94	73.61	72.84	80.12	82.84	88.07	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	131.56	131.56	131.56	131.56	131.56	131.56	131.56	131.56	131.56	131.56	131.56	131.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.38	18.99	15.44	11.69	8.74	7.38	7.97	10.36	13.91	17.66	20.61	21.97	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	239.81	242.3	236.03	222.68	205.83	189.99	179.41	176.92	183.19	196.54	213.39	229.23	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	(69)
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Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-105.25	-105.25	-105.25	-105.25	-105.25	-105.25	-105.25	-105.25	-105.25	-105.25	-105.25	-105.25	(71)
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Water heating gains (Table 5)

(72)m=	120.59	118.36	113.72	107.41	103.32	97.56	92.66	98.93	101.17	107.69	115.06	118.37	(72)
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**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	447.25	445.11	430.66	407.25	383.35	360.39	345.5	351.68	363.73	387.36	414.53	435.04	(73)
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## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor	Area	Flux	g <sub>o</sub>	FF	Gains
	Table 6d	m <sup>2</sup>	Table 6a	Table 6b	Table 6c	(W)

## TER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	8.73	x	19.64	x	0.63	x	0.7	=	52.4	(76)
East	0.9x	0.77	x	1.42	x	19.64	x	0.63	x	0.7	=	8.52	(76)
East	0.9x	0.77	x	3.78	x	19.64	x	0.63	x	0.7	=	22.69	(76)
East	0.9x	0.77	x	1.42	x	19.64	x	0.63	x	0.7	=	8.52	(76)
East	0.9x	0.77	x	8.73	x	38.42	x	0.63	x	0.7	=	102.51	(76)
East	0.9x	0.77	x	1.42	x	38.42	x	0.63	x	0.7	=	16.67	(76)
East	0.9x	0.77	x	3.78	x	38.42	x	0.63	x	0.7	=	44.38	(76)
East	0.9x	0.77	x	1.42	x	38.42	x	0.63	x	0.7	=	16.67	(76)
East	0.9x	0.77	x	8.73	x	63.27	x	0.63	x	0.7	=	168.81	(76)
East	0.9x	0.77	x	1.42	x	63.27	x	0.63	x	0.7	=	27.46	(76)
East	0.9x	0.77	x	3.78	x	63.27	x	0.63	x	0.7	=	73.09	(76)
East	0.9x	0.77	x	1.42	x	63.27	x	0.63	x	0.7	=	27.46	(76)
East	0.9x	0.77	x	8.73	x	92.28	x	0.63	x	0.7	=	246.2	(76)
East	0.9x	0.77	x	1.42	x	92.28	x	0.63	x	0.7	=	40.05	(76)
East	0.9x	0.77	x	3.78	x	92.28	x	0.63	x	0.7	=	106.6	(76)
East	0.9x	0.77	x	1.42	x	92.28	x	0.63	x	0.7	=	40.05	(76)
East	0.9x	0.77	x	8.73	x	113.09	x	0.63	x	0.7	=	301.73	(76)
East	0.9x	0.77	x	1.42	x	113.09	x	0.63	x	0.7	=	49.08	(76)
East	0.9x	0.77	x	3.78	x	113.09	x	0.63	x	0.7	=	130.65	(76)
East	0.9x	0.77	x	1.42	x	113.09	x	0.63	x	0.7	=	49.08	(76)
East	0.9x	0.77	x	8.73	x	115.77	x	0.63	x	0.7	=	308.88	(76)
East	0.9x	0.77	x	1.42	x	115.77	x	0.63	x	0.7	=	50.24	(76)
East	0.9x	0.77	x	3.78	x	115.77	x	0.63	x	0.7	=	133.74	(76)
East	0.9x	0.77	x	1.42	x	115.77	x	0.63	x	0.7	=	50.24	(76)
East	0.9x	0.77	x	8.73	x	110.22	x	0.63	x	0.7	=	294.06	(76)
East	0.9x	0.77	x	1.42	x	110.22	x	0.63	x	0.7	=	47.83	(76)
East	0.9x	0.77	x	3.78	x	110.22	x	0.63	x	0.7	=	127.33	(76)
East	0.9x	0.77	x	1.42	x	110.22	x	0.63	x	0.7	=	47.83	(76)
East	0.9x	0.77	x	8.73	x	94.68	x	0.63	x	0.7	=	252.6	(76)
East	0.9x	0.77	x	1.42	x	94.68	x	0.63	x	0.7	=	41.09	(76)
East	0.9x	0.77	x	3.78	x	94.68	x	0.63	x	0.7	=	109.37	(76)
East	0.9x	0.77	x	1.42	x	94.68	x	0.63	x	0.7	=	41.09	(76)
East	0.9x	0.77	x	8.73	x	73.59	x	0.63	x	0.7	=	196.34	(76)
East	0.9x	0.77	x	1.42	x	73.59	x	0.63	x	0.7	=	31.94	(76)
East	0.9x	0.77	x	3.78	x	73.59	x	0.63	x	0.7	=	85.01	(76)
East	0.9x	0.77	x	1.42	x	73.59	x	0.63	x	0.7	=	31.94	(76)
East	0.9x	0.77	x	8.73	x	45.59	x	0.63	x	0.7	=	121.63	(76)
East	0.9x	0.77	x	1.42	x	45.59	x	0.63	x	0.7	=	19.78	(76)
East	0.9x	0.77	x	3.78	x	45.59	x	0.63	x	0.7	=	52.67	(76)
East	0.9x	0.77	x	1.42	x	45.59	x	0.63	x	0.7	=	19.78	(76)
East	0.9x	0.77	x	8.73	x	24.49	x	0.63	x	0.7	=	65.34	(76)

## TER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	1.42	x	24.49	x	0.63	x	0.7	=	10.63	(76)
East	0.9x	0.77	x	3.78	x	24.49	x	0.63	x	0.7	=	28.29	(76)
East	0.9x	0.77	x	1.42	x	24.49	x	0.63	x	0.7	=	10.63	(76)
East	0.9x	0.77	x	8.73	x	16.15	x	0.63	x	0.7	=	43.09	(76)
East	0.9x	0.77	x	1.42	x	16.15	x	0.63	x	0.7	=	7.01	(76)
East	0.9x	0.77	x	3.78	x	16.15	x	0.63	x	0.7	=	18.66	(76)
East	0.9x	0.77	x	1.42	x	16.15	x	0.63	x	0.7	=	7.01	(76)
South	0.9x	0.77	x	3.73	x	46.75	x	0.63	x	0.7	=	53.29	(78)
South	0.9x	0.77	x	2.11	x	46.75	x	0.63	x	0.7	=	30.15	(78)
South	0.9x	0.77	x	1.42	x	46.75	x	0.63	x	0.7	=	20.29	(78)
South	0.9x	0.77	x	3.73	x	76.57	x	0.63	x	0.7	=	87.28	(78)
South	0.9x	0.77	x	2.11	x	76.57	x	0.63	x	0.7	=	49.37	(78)
South	0.9x	0.77	x	1.42	x	76.57	x	0.63	x	0.7	=	33.23	(78)
South	0.9x	0.77	x	3.73	x	97.53	x	0.63	x	0.7	=	111.18	(78)
South	0.9x	0.77	x	2.11	x	97.53	x	0.63	x	0.7	=	62.89	(78)
South	0.9x	0.77	x	1.42	x	97.53	x	0.63	x	0.7	=	42.33	(78)
South	0.9x	0.77	x	3.73	x	110.23	x	0.63	x	0.7	=	125.66	(78)
South	0.9x	0.77	x	2.11	x	110.23	x	0.63	x	0.7	=	71.08	(78)
South	0.9x	0.77	x	1.42	x	110.23	x	0.63	x	0.7	=	47.84	(78)
South	0.9x	0.77	x	3.73	x	114.87	x	0.63	x	0.7	=	130.95	(78)
South	0.9x	0.77	x	2.11	x	114.87	x	0.63	x	0.7	=	74.07	(78)
South	0.9x	0.77	x	1.42	x	114.87	x	0.63	x	0.7	=	49.85	(78)
South	0.9x	0.77	x	3.73	x	110.55	x	0.63	x	0.7	=	126.02	(78)
South	0.9x	0.77	x	2.11	x	110.55	x	0.63	x	0.7	=	71.29	(78)
South	0.9x	0.77	x	1.42	x	110.55	x	0.63	x	0.7	=	47.97	(78)
South	0.9x	0.77	x	3.73	x	108.01	x	0.63	x	0.7	=	123.13	(78)
South	0.9x	0.77	x	2.11	x	108.01	x	0.63	x	0.7	=	69.65	(78)
South	0.9x	0.77	x	1.42	x	108.01	x	0.63	x	0.7	=	46.87	(78)
South	0.9x	0.77	x	3.73	x	104.89	x	0.63	x	0.7	=	119.57	(78)
South	0.9x	0.77	x	2.11	x	104.89	x	0.63	x	0.7	=	67.64	(78)
South	0.9x	0.77	x	1.42	x	104.89	x	0.63	x	0.7	=	45.52	(78)
South	0.9x	0.77	x	3.73	x	101.89	x	0.63	x	0.7	=	116.14	(78)
South	0.9x	0.77	x	2.11	x	101.89	x	0.63	x	0.7	=	65.7	(78)
South	0.9x	0.77	x	1.42	x	101.89	x	0.63	x	0.7	=	44.22	(78)
South	0.9x	0.77	x	3.73	x	82.59	x	0.63	x	0.7	=	94.14	(78)
South	0.9x	0.77	x	2.11	x	82.59	x	0.63	x	0.7	=	53.25	(78)
South	0.9x	0.77	x	1.42	x	82.59	x	0.63	x	0.7	=	35.84	(78)
South	0.9x	0.77	x	3.73	x	55.42	x	0.63	x	0.7	=	63.17	(78)
South	0.9x	0.77	x	2.11	x	55.42	x	0.63	x	0.7	=	35.74	(78)
South	0.9x	0.77	x	1.42	x	55.42	x	0.63	x	0.7	=	24.05	(78)
South	0.9x	0.77	x	3.73	x	40.4	x	0.63	x	0.7	=	46.05	(78)

## TER WorkSheet: New dwelling design stage

South  $0.9 \times \boxed{0.77} \times \boxed{2.11} \times \boxed{40.4} \times \boxed{0.63} \times \boxed{0.7} = \boxed{26.05}$  (78)

South  $0.9 \times \boxed{0.77} \times \boxed{1.42} \times \boxed{40.4} \times \boxed{0.63} \times \boxed{0.7} = \boxed{17.53}$  (78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	195.87	350.12	513.23	677.48	785.41	788.38	756.7	676.87	571.28	397.1	237.84	165.4	(83)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	--------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	643.12	795.24	943.89	1084.74	1168.76	1148.77	1102.21	1028.56	935.01	784.46	652.37	600.44	(84)
--------	--------	--------	--------	---------	---------	---------	---------	---------	--------	--------	--------	--------	------

### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)  (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.98	0.95	0.84	0.67	0.48	0.34	0.38	0.62	0.91	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.09	20.3	20.58	20.84	20.96	21	21	21	20.98	20.79	20.38	20.05	(87)
--------	-------	------	-------	-------	-------	----	----	----	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.09	20.1	20.1	20.11	20.11	20.12	20.12	20.12	20.12	20.11	20.11	20.1	(88)
--------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.93	0.81	0.61	0.41	0.28	0.31	0.55	0.88	0.98	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.88	19.2	19.59	19.94	20.08	20.12	20.12	20.12	20.1	19.88	19.32	18.84	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

fLA = Living area ÷ (4) =  (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.28	19.56	19.91	20.23	20.37	20.4	20.41	20.41	20.39	20.18	19.66	19.23	(92)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.28	19.56	19.91	20.23	20.37	20.4	20.41	20.41	20.39	20.18	19.66	19.23	(93)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

### 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.93	0.81	0.63	0.43	0.3	0.34	0.57	0.88	0.98	0.99	(94)
--------	------	------	------	------	------	------	-----	------	------	------	------	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	637.88	776.08	878.15	881.14	734.68	499.1	328.6	345.02	535.65	689.47	639.11	596.96	(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=	1337.02	1304.7	1190.46	993.04	757.55	501.32	328.8	345.4	545.79	837.13	1103.55	1327.16	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	520.16	355.23	232.36	80.57	17.01	0	0	0	0	109.85	334.4	543.27	
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Total per year (kWh/year) = Sum(98)...59...12 =  (98)

Space heating requirement in kWh/m<sup>2</sup>/year  (99)

### 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

Fraction of space heat from secondary/supplementary system  (201)



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Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement (calculated above)													kWh/year	
	520.16	355.23	232.36	80.57	17.01	0	0	0	0	109.85	334.4	543.27		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)	
	556.32	379.92	248.51	86.17	18.19	0	0	0	0	117.49	357.65	581.04		
	Total (kWh/year) = Sum(211) <sub>1...5,10...12</sub> =												2345.29	(211)

Space heating fuel (secondary), kWh/month	= {[(98)m x (201)] } x 100 ÷ (208)				
(215)m =	0	0	0		
	0	0	0		
	0	0	0		
	0	0	0		
	0	0	0		
	0	0	0		
	0	0	0		
	Total (kWh/year) = Sum(215) <sub>1...5,10...12</sub> =			0	(215)

### Water heating

Output from water heater (calculated above)					
	204.32	180.03	188.95		
	169.2	165.68	147.85		
	141.82	155.86	155.66		
	175.46	185.75	199.35		
Efficiency of water heater				79.8	(216)
(217)m =	87.2	86.59	85.37		
	82.96	80.69	79.8		
	79.8	79.8	79.8		
	79.8	79.8	79.8		
	83.61	86.36	87.36		
Fuel for water heating, kWh/month					
(219)m = (64)m x 100 ÷ (217)m					
(219)m =	234.31	207.91	221.34		
	203.94	205.33	185.28		
	177.71	195.32	195.07		
	209.86	215.08	228.2		
	Total = Sum(219a) <sub>1...12</sub> =			2479.34	(219)

### Annual totals

	<b>kWh/year</b>	<b>kWh/year</b>
Space heating fuel used, main system 1		2345.29
Water heating fuel used		2479.34
Electricity for pumps, fans and electric keep-hot		
central heating pump:		30
boiler with a fan-assisted flue		45
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75
Electricity for lighting		377.57

### 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	=	506.58
Space heating (secondary)	(215) x	=	0.519	=	0
Water heating	(219) x	=	0.216	=	535.54
Space and water heating	(261) + (262) + (263) + (264) =			=	1042.12
Electricity for pumps, fans and electric keep-hot	(231) x	=	0.519	=	38.93
Electricity for lighting	(232) x	=	0.519	=	195.96

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Total CO2, kg/year

sum of (265)...(271) =

1277

(272)

**TER =**

14.13

(273)

# DER WorkSheet: New dwelling design stage

## User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

Property Address: GT 304 - Be Lean

**Address :** GT 304, Aspen Court, Maitland Park Estate, London, NW3 2EH

## 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	72.3	(1a) x	2.6	(2a) =	187.98
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	72.3	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	187.98

## 2. Ventilation rate:

	main heating		secondary heating		other		total		m <sup>3</sup> per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0
Number of open flues	0	+	0	+	0	=	0	x 20 =	0
Number of intermittent fans							0	x 10 =	0
Number of passive vents							0	x 10 =	0
Number of flueless gas fires							0	x 40 =	0

### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			2	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.1	(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.08	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1
------	------	-----	------	------	------	------	------	------	------	-----	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (25)

**3. Heat losses and heat loss parameter:**

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			2.24	x1/[1/( 1.4 )+ 0.04] =	2.97		(27)
Windows Type 2			2.24	x1/[1/( 1.4 )+ 0.04] =	2.97		(27)
Windows Type 3			1.5	x1/[1/( 1.4 )+ 0.04] =	1.99		(27)
Windows Type 4			6.73	x1/[1/( 1.4 )+ 0.04] =	8.92		(27)
Walls	33.88	12.71	21.17	x 0.12 =	2.54		(29)
Roof	14.9	0	14.9	x 0.1 =	1.49		(30)
Total area of elements, m <sup>2</sup>			48.78				(31)
Party wall			54.18	x 0 =	0		(32)

\* for windows and roof windows, use effective window U-value calculated using formula 1/[1/U-value+0.04] as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 20.88 (33)

Heat capacity Cm = S(A x k ) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.78 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 27.66 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	14.01	13.88	13.75	13.09	12.96	12.3	12.3	12.17	12.56	12.96	13.22	13.48

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	41.68	41.54	41.41	40.75	40.62	39.96	39.96	39.83	40.23	40.62	40.88	41.15
	Average = Sum(39) <sub>1...12</sub> /12=											40.72 (39)

# DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.58	0.57	0.57	0.56	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.57	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.56	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

**4. Water heating energy requirement: kWh/year:**

Assumed occupancy, N 2.3 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)  
if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 88.84 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	97.72	94.17	90.62	87.06	83.51	79.96	79.96	83.51	87.06	90.62	94.17	97.72	(44)
Total = Sum(44) <sub>1...12</sub> =												1066.08	

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	144.92	126.75	130.79	114.03	109.41	94.42	87.49	100.4	101.6	118.4	129.24	140.35	(45)
Total = Sum(45) <sub>1...12</sub> =												1397.8	

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m= 21.74 19.01 19.62 17.1 16.41 14.16 13.12 15.06 15.24 17.76 19.39 21.05 (46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month (56)m = (55) x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

# DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	200.2	176.68	186.07	167.52	164.69	147.91	142.77	155.67	155.09	173.68	182.74	195.63	(62)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	200.2	176.68	186.07	167.52	164.69	147.91	142.77	155.67	155.09	173.68	182.74	195.63		
<b>Output from water heater (annual)<sub>1...12</sub></b>												2048.64	(64)	

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	92.41	82.09	87.71	80.71	80.6	74.19	73.31	77.6	76.58	83.59	85.77	90.89	(65)
--------	-------	-------	-------	-------	------	-------	-------	------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	115.03	115.03	115.03	115.03	115.03	115.03	115.03	115.03	115.03	115.03	115.03	115.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.18	16.15	13.13	9.94	7.43	6.27	6.78	8.81	11.83	15.02	17.53	18.69	(67)
--------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	202.6	204.71	199.41	188.13	173.89	160.51	151.57	149.47	154.77	166.05	180.28	193.67	(68)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	124.2	122.15	117.89	112.1	108.34	103.04	98.54	104.31	106.35	112.35	119.12	122.16	(72)
--------	-------	--------	--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	------

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	402.5	400.52	387.94	367.68	347.17	327.33	314.4	320.1	330.46	350.93	374.44	392.02	(73)
--------	-------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	------

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub>g</sub> Table 6b	FF Table 6c	Gains (W)	
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">2.24</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">10.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.4</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.8</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">5.28</table>	(74)
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">1.5</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">10.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.4</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.8</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">3.54</table>	(74)
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">6.73</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">10.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.4</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.8</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">15.87</table>	(74)
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">2.24</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">20.32</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.4</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.8</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">10.09</table>	(74)
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">1.5</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">20.32</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.4</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.8</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">6.76</table>	(74)

## DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	6.73	x	20.32	x	0.4	x	0.8	=	30.33	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.4	x	0.8	=	17.15	(74)
North	0.9x	0.77	x	1.5	x	34.53	x	0.4	x	0.8	=	11.49	(74)
North	0.9x	0.77	x	6.73	x	34.53	x	0.4	x	0.8	=	51.53	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.4	x	0.8	=	27.55	(74)
North	0.9x	0.77	x	1.5	x	55.46	x	0.4	x	0.8	=	18.45	(74)
North	0.9x	0.77	x	6.73	x	55.46	x	0.4	x	0.8	=	82.78	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.4	x	0.8	=	37.11	(74)
North	0.9x	0.77	x	1.5	x	74.72	x	0.4	x	0.8	=	24.85	(74)
North	0.9x	0.77	x	6.73	x	74.72	x	0.4	x	0.8	=	111.51	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.4	x	0.8	=	39.73	(74)
North	0.9x	0.77	x	1.5	x	79.99	x	0.4	x	0.8	=	26.61	(74)
North	0.9x	0.77	x	6.73	x	79.99	x	0.4	x	0.8	=	119.37	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.4	x	0.8	=	37.1	(74)
North	0.9x	0.77	x	1.5	x	74.68	x	0.4	x	0.8	=	24.84	(74)
North	0.9x	0.77	x	6.73	x	74.68	x	0.4	x	0.8	=	111.45	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.4	x	0.8	=	29.43	(74)
North	0.9x	0.77	x	1.5	x	59.25	x	0.4	x	0.8	=	19.71	(74)
North	0.9x	0.77	x	6.73	x	59.25	x	0.4	x	0.8	=	88.42	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.4	x	0.8	=	20.62	(74)
North	0.9x	0.77	x	1.5	x	41.52	x	0.4	x	0.8	=	13.81	(74)
North	0.9x	0.77	x	6.73	x	41.52	x	0.4	x	0.8	=	61.96	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.4	x	0.8	=	12.02	(74)
North	0.9x	0.77	x	1.5	x	24.19	x	0.4	x	0.8	=	8.05	(74)
North	0.9x	0.77	x	6.73	x	24.19	x	0.4	x	0.8	=	36.1	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.4	x	0.8	=	6.52	(74)
North	0.9x	0.77	x	1.5	x	13.12	x	0.4	x	0.8	=	4.36	(74)
North	0.9x	0.77	x	6.73	x	13.12	x	0.4	x	0.8	=	19.58	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.4	x	0.8	=	4.4	(74)
North	0.9x	0.77	x	1.5	x	8.86	x	0.4	x	0.8	=	2.95	(74)
North	0.9x	0.77	x	6.73	x	8.86	x	0.4	x	0.8	=	13.23	(74)
South	0.9x	0.77	x	2.24	x	46.75	x	0.4	x	0.8	=	23.22	(78)
South	0.9x	0.77	x	2.24	x	76.57	x	0.4	x	0.8	=	38.03	(78)
South	0.9x	0.77	x	2.24	x	97.53	x	0.4	x	0.8	=	48.45	(78)
South	0.9x	0.77	x	2.24	x	110.23	x	0.4	x	0.8	=	54.76	(78)
South	0.9x	0.77	x	2.24	x	114.87	x	0.4	x	0.8	=	57.06	(78)
South	0.9x	0.77	x	2.24	x	110.55	x	0.4	x	0.8	=	54.91	(78)
South	0.9x	0.77	x	2.24	x	108.01	x	0.4	x	0.8	=	53.65	(78)
South	0.9x	0.77	x	2.24	x	104.89	x	0.4	x	0.8	=	52.11	(78)
South	0.9x	0.77	x	2.24	x	101.89	x	0.4	x	0.8	=	50.61	(78)
South	0.9x	0.77	x	2.24	x	82.59	x	0.4	x	0.8	=	41.02	(78)

## DER WorkSheet: New dwelling design stage

South  $0.9 \times \boxed{0.77} \times \boxed{2.24} \times \boxed{55.42} \times \boxed{0.4} \times \boxed{0.8} = \boxed{27.53}$  (78)  
 South  $0.9 \times \boxed{0.77} \times \boxed{2.24} \times \boxed{40.4} \times \boxed{0.4} \times \boxed{0.8} = \boxed{20.07}$  (78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	47.91	85.22	128.62	183.54	230.54	240.63	227.04	189.67	147.01	97.19	57.98	40.65	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	450.41	485.73	516.56	551.22	577.71	567.96	541.44	509.76	477.47	448.11	432.43	432.67	(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
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 (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	0.95	0.84	0.65	0.45	0.32	0.36	0.58	0.87	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.64	20.72	20.84	20.96	21	21	21	21	21	20.95	20.79	20.62	(87)
--------	-------	-------	-------	-------	----	----	----	----	----	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.45	20.45	20.45	20.46	20.46	20.47	20.47	20.47	20.47	20.46	20.46	20.46	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.94	0.82	0.61	0.41	0.29	0.32	0.54	0.84	0.97	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.97	20.09	20.26	20.42	20.46	20.47	20.47	20.47	20.47	20.42	20.19	19.95	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 

0.38
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 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.22	20.33	20.48	20.63	20.66	20.67	20.67	20.67	20.67	20.62	20.42	20.2	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.22	20.33	20.48	20.63	20.66	20.67	20.67	20.67	20.67	20.62	20.42	20.2	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

### 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.94	0.83	0.63	0.43	0.3	0.33	0.55	0.85	0.97	0.99	(94)
--------	------	------	------	------	------	------	-----	------	------	------	------	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	445.95	475.58	487.68	455.62	362.24	242.65	162.77	170.24	263.82	382.57	420.6	429.43	(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)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m ]

(97)m=	663.65	641.1	579.08	477.84	364.15	242.7	162.78	170.25	264.3	407.1	544.61	658.56	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	161.97	111.23	68	16	1.42	0	0	0	0	18.25	89.29	170.48	
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Total per year (kWh/year) = Sum(98)...5,9...12 = 

636.63
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 (98)

Space heating requirement in kWh/m<sup>2</sup>/year 

8.81
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 (99)

### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.



## DER WorkSheet: New dwelling design stage

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)
<i>The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.</i>		
Fraction of heat from Community boilers	1	(303a)
Fraction of total space heat from Community boilers <span style="float: right;">(302) x (303a) =</span>	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system	1	(305)
Distribution loss factor (Table 12c) for community heating system	1.1	(306)
<b>Space heating</b>		
<b>kWh/year</b>		
Annual space heating requirement	636.63	
Space heat from Community boilers <span style="float: right;">(98) x (304a) x (305) x (306) =</span>	700.3	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0	(308)
Space heating requirement from secondary/supplementary system <span style="float: right;">(98) x (301) x 100 ÷ (308) =</span>	0	(309)
<b>Water heating</b>		
Annual water heating requirement	2048.64	
If DHW from community scheme: Water heat from Community boilers <span style="float: right;">(64) x (303a) x (305) x (306) =</span>	2253.51	(310a)
Electricity used for heat distribution <span style="float: right;">0.01 x [(307a)...(307e) + (310a)...(310e)] =</span>	29.54	(313)
Cooling System Energy Efficiency Ratio	0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0) <span style="float: right;">= (107) ÷ (314) =</span>	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	151.93	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year <span style="float: right;">=(330a) + (330b) + (330g) =</span>	151.93	(331)
Energy for lighting (calculated in Appendix L)	321.08	(332)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)				
Efficiency of heat source 1 (%) <span style="float: right;"><i>If there is CHP using two fuels repeat (363) to (366) for the second fuel</i></span>			95	(367a)
CO2 associated with heat source 1 <span style="float: right;">[(307b)+(310b)] x 100 ÷ (367b) x</span>		0.22	=	671.6 (367)
Electrical energy for heat distribution <span style="float: right;">[(313) x</span>		0.52	=	15.33 (372)
Total CO2 associated with community systems <span style="float: right;">(363)...(366) + (368)...(372)</span>			=	686.93 (373)
CO2 associated with space heating (secondary) <span style="float: right;">(309) x</span>		0	=	0 (374)
CO2 associated with water from immersion heater or instantaneous heater <span style="float: right;">(312) x</span>		0.22	=	0 (375)
Total CO2 associated with space and water heating <span style="float: right;">(373) + (374) + (375) =</span>				686.93 (376)
CO2 associated with electricity for pumps and fans within dwelling <span style="float: right;">(331) x</span>		0.52	=	78.85 (378)

## DER WorkSheet: New dwelling design stage

CO2 associated with electricity for lighting	(332)) x	0.52	=	166.64	(379)
<b>Total CO2, kg/year</b>	sum of (376)...(382) =			932.43	(383)
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =			12.9	(384)
<b>EI rating (section 14)</b>				89.35	(385)



# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.44	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:  (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)  (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =  (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58
-----	------	------	------	------	------	------	------	------	------	------	------

(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 

0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58
-----	------	------	------	------	------	------	------	------	------	------	------

(25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			<input type="text" value="2.24"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.97"/>		(27)
Windows Type 2			<input type="text" value="2.24"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.97"/>		(27)
Windows Type 3			<input type="text" value="1.5"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.99"/>		(27)
Windows Type 4			<input type="text" value="6.73"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="8.92"/>		(27)
Walls	<input type="text" value="33.88"/>	<input type="text" value="12.71"/>	<input type="text" value="21.17"/>	$x$ <input type="text" value="0.18"/>	$=$ <input type="text" value="3.81"/>	<input type="text"/>	(29)
Roof	<input type="text" value="14.9"/>	<input type="text" value="0"/>	<input type="text" value="14.9"/>	$x$ <input type="text" value="0.13"/>	$=$ <input type="text" value="1.94"/>	<input type="text"/>	(30)
Total area of elements, m <sup>2</sup>			<input type="text" value="48.78"/>				(31)
Party wall			<input type="text" value="54.18"/>	$x$ <input type="text" value="0"/>	$=$ <input type="text" value="0"/>	<input type="text"/>	(32)

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[1/U\text{-value}+0.04]$  as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) =  (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) =  (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium  (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  (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) =  (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	37.13	36.89	36.66	35.57	35.36	34.41	34.41	34.23	34.78	35.36	35.77	36.21

(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	64.68	64.44	64.21	63.11	62.91	61.96	61.96	61.78	62.32	62.91	63.32	63.75
	Average = Sum(39) <sub>1...12</sub> /12= <input type="text" value="63.11"/> (39)											

# TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.89	0.89	0.89	0.87	0.87	0.86	0.86	0.85	0.86	0.87	0.88	0.88	
	Average = Sum(40) <sub>1...12</sub> / 12 =											0.87	(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 2.3 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)  
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 88.84 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	97.72	94.17	90.62	87.06	83.51	79.96	79.96	83.51	87.06	90.62	94.17	97.72	
	Total = Sum(44) <sub>1...12</sub> =											1066.08	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	144.92	126.75	130.79	114.03	109.41	94.42	87.49	100.4	101.6	118.4	129.24	140.35	
	Total = Sum(45) <sub>1...12</sub> =											1397.8	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m= 21.74 19.01 19.62 17.1 16.41 14.16 13.12 15.06 15.24 17.76 19.39 21.05 (46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (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) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) x (41)m)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	191.52	168.84	177.39	159.12	156.01	139.51	134.09	146.99	146.69	165	174.33	186.94	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	191.52	168.84	177.39	159.12	156.01	139.51	134.09	146.99	146.69	165	174.33	186.94		
												Output from water heater (annual) <sub>1...12</sub>	1946.42 (64)	

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	85.46	75.81	80.77	73.99	73.66	67.47	66.37	70.66	69.85	76.64	79.05	83.94	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	115.03	115.03	115.03	115.03	115.03	115.03	115.03	115.03	115.03	115.03	115.03	115.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.52	16.45	13.38	10.13	7.57	6.39	6.91	8.98	12.05	15.3	17.86	19.03	(67)
--------	-------	-------	-------	-------	------	------	------	------	-------	------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	202.6	204.71	199.41	188.13	173.89	160.51	151.57	149.47	154.77	166.05	180.28	193.67	(68)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	(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=	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	114.87	112.82	108.56	102.76	99	93.7	89.2	94.97	97.02	103.02	109.79	112.83	(72)
--------	--------	--------	--------	--------	----	------	------	-------	-------	--------	--------	--------	------

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	396.5	394.48	381.85	361.53	340.97	321.12	308.19	313.93	324.35	344.87	368.44	386.03	(73)
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## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub>g</sub> Table 6b	FF Table 6c	Gains (W)	
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">2.24</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">10.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.7</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">7.28</table>	(74)
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">1.5</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">10.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.7</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">4.87</table>	(74)
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">6.73</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">10.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.7</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">21.87</table>	(74)
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">2.24</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">20.32</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.7</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">13.91</table>	(74)
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">1.5</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">20.32</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.7</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">9.32</table>	(74)

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North	0.9x	0.77	x	6.73	x	20.32	x	0.63	x	0.7	=	41.8	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.63	x	0.7	=	23.64	(74)
North	0.9x	0.77	x	1.5	x	34.53	x	0.63	x	0.7	=	15.83	(74)
North	0.9x	0.77	x	6.73	x	34.53	x	0.63	x	0.7	=	71.02	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.63	x	0.7	=	37.97	(74)
North	0.9x	0.77	x	1.5	x	55.46	x	0.63	x	0.7	=	25.43	(74)
North	0.9x	0.77	x	6.73	x	55.46	x	0.63	x	0.7	=	114.08	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.63	x	0.7	=	51.15	(74)
North	0.9x	0.77	x	1.5	x	74.72	x	0.63	x	0.7	=	34.25	(74)
North	0.9x	0.77	x	6.73	x	74.72	x	0.63	x	0.7	=	153.67	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.63	x	0.7	=	54.76	(74)
North	0.9x	0.77	x	1.5	x	79.99	x	0.63	x	0.7	=	36.67	(74)
North	0.9x	0.77	x	6.73	x	79.99	x	0.63	x	0.7	=	164.51	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.63	x	0.7	=	51.12	(74)
North	0.9x	0.77	x	1.5	x	74.68	x	0.63	x	0.7	=	34.23	(74)
North	0.9x	0.77	x	6.73	x	74.68	x	0.63	x	0.7	=	153.59	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.63	x	0.7	=	40.56	(74)
North	0.9x	0.77	x	1.5	x	59.25	x	0.63	x	0.7	=	27.16	(74)
North	0.9x	0.77	x	6.73	x	59.25	x	0.63	x	0.7	=	121.86	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.63	x	0.7	=	28.42	(74)
North	0.9x	0.77	x	1.5	x	41.52	x	0.63	x	0.7	=	19.03	(74)
North	0.9x	0.77	x	6.73	x	41.52	x	0.63	x	0.7	=	85.39	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.63	x	0.7	=	16.56	(74)
North	0.9x	0.77	x	1.5	x	24.19	x	0.63	x	0.7	=	11.09	(74)
North	0.9x	0.77	x	6.73	x	24.19	x	0.63	x	0.7	=	49.75	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.63	x	0.7	=	8.98	(74)
North	0.9x	0.77	x	1.5	x	13.12	x	0.63	x	0.7	=	6.01	(74)
North	0.9x	0.77	x	6.73	x	13.12	x	0.63	x	0.7	=	26.98	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.63	x	0.7	=	6.07	(74)
North	0.9x	0.77	x	1.5	x	8.86	x	0.63	x	0.7	=	4.06	(74)
North	0.9x	0.77	x	6.73	x	8.86	x	0.63	x	0.7	=	18.23	(74)
South	0.9x	0.77	x	2.24	x	46.75	x	0.63	x	0.7	=	32.01	(78)
South	0.9x	0.77	x	2.24	x	76.57	x	0.63	x	0.7	=	52.42	(78)
South	0.9x	0.77	x	2.24	x	97.53	x	0.63	x	0.7	=	66.77	(78)
South	0.9x	0.77	x	2.24	x	110.23	x	0.63	x	0.7	=	75.46	(78)
South	0.9x	0.77	x	2.24	x	114.87	x	0.63	x	0.7	=	78.64	(78)
South	0.9x	0.77	x	2.24	x	110.55	x	0.63	x	0.7	=	75.68	(78)
South	0.9x	0.77	x	2.24	x	108.01	x	0.63	x	0.7	=	73.94	(78)
South	0.9x	0.77	x	2.24	x	104.89	x	0.63	x	0.7	=	71.81	(78)
South	0.9x	0.77	x	2.24	x	101.89	x	0.63	x	0.7	=	69.75	(78)
South	0.9x	0.77	x	2.24	x	82.59	x	0.63	x	0.7	=	56.54	(78)

## TER WorkSheet: New dwelling design stage

South  $0.9 \times \boxed{0.77} \times \boxed{2.24} \times \boxed{55.42} \times \boxed{0.63} \times \boxed{0.7} = \boxed{37.94}$  (78)

South  $0.9 \times \boxed{0.77} \times \boxed{2.24} \times \boxed{40.4} \times \boxed{0.63} \times \boxed{0.7} = \boxed{27.66}$  (78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	66.03	117.44	177.26	252.94	317.71	331.61	312.89	261.38	202.59	133.94	79.91	56.02	(83)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	462.53	511.92	559.11	614.47	658.68	652.73	621.08	575.31	526.94	478.81	448.35	442.05	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 

21
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 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.81	0.6	0.44	0.49	0.76	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.16	20.28	20.48	20.74	20.93	20.99	21	21	20.96	20.73	20.41	20.14	(87)
--------	-------	-------	-------	-------	-------	-------	----	----	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.17	20.17	20.18	20.19	20.19	20.2	20.2	20.21	20.2	20.19	20.19	20.18	(88)
--------	-------	-------	-------	-------	-------	------	------	-------	------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.92	0.76	0.53	0.36	0.41	0.69	0.94	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.04	19.22	19.51	19.89	20.12	20.2	20.2	20.21	20.17	19.89	19.42	19.03	(90)
--------	-------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 

0.38
------

 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.47	19.62	19.88	20.22	20.43	20.5	20.51	20.51	20.47	20.21	19.79	19.45	(92)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.47	19.62	19.88	20.22	20.43	20.5	20.51	20.51	20.47	20.21	19.79	19.45	(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	0.99	0.97	0.92	0.77	0.55	0.39	0.44	0.72	0.94	0.99	1	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	460.17	506.7	544.94	564.6	509.85	361.56	241.67	252.98	378.67	450.93	443.22	440.3	(95)
--------	--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m ]

(97)m=	980.91	948.84	859.18	714.22	549.17	365.54	242.02	253.72	397.1	604.46	803.76	972.24	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	387.43	297.12	233.8	107.73	29.25	0	0	0	0	114.23	259.59	395.76	
--------	--------	--------	-------	--------	-------	---	---	---	---	--------	--------	--------	--

Total per year (kWh/year) = Sum(98)...59...12 = 

1824.91
---------

 (98)

Space heating requirement in kWh/m<sup>2</sup>/year 

25.24
-------

 (99)

### 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

Fraction of space heat from secondary/supplementary system 

0
---

 (201)



## TER WorkSheet: New dwelling design stage

Fraction of space heat from main system(s)	$(202) = 1 - (201) =$	1	(202)
Fraction of total heating from main system 1	$(204) = (202) \times [1 - (203)] =$	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement (calculated above)													kWh/year	
	387.43	297.12	233.8	107.73	29.25	0	0	0	0	114.23	259.59	395.76		
$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$													(211)	
	414.37	317.77	250.05	115.22	31.28	0	0	0	0	122.17	277.64	423.27		
	$Total (kWh/year) = Sum(211)_{1..5,10..12} =$												1951.77	(211)

Space heating fuel (secondary), kWh/month	$= \{[(98)m \times (201)]\} \times 100 \div (208)$				
$(215)m =$	0	0	0		
	0	0	0		
	0	0	0		
	0	0	0		
	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)					
	191.52	168.84	177.39		
	159.12	156.01	139.51		
	134.09	146.99	146.69		
	165	174.33	186.94		
Efficiency of water heater				79.8	(216)
$(217)m =$	86.66	86.31	85.55		
	83.8	81.32	79.8		
	79.8	79.8	79.8		
	79.8	79.8	79.8		
	83.86	85.87	86.77		
Fuel for water heating, kWh/month					
$(219)m = (64)m \times 100 \div (217)m$					
$(219)m =$	221.01	195.62	207.35		
	189.88	191.85	174.82		
	168.03	184.2	183.82		
	196.76	203.01	215.45		
	$Total = Sum(219a)_{1..12} =$			2331.81	(219)

### Annual totals

	<b>kWh/year</b>	<b>kWh/year</b>
Space heating fuel used, main system 1		1951.77
Water heating fuel used		2331.81
Electricity for pumps, fans and electric keep-hot		
central heating pump:		30
boiler with a fan-assisted flue		45
Total electricity for the above, kWh/year	$sum\ of\ (230a)...(230g) =$	75
Electricity for lighting		327.07

### 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	=	421.58
Space heating (secondary)	(215) x	=	0.519	=	0
Water heating	(219) x	=	0.216	=	503.67
Space and water heating	$(261) + (262) + (263) + (264) =$				925.25
Electricity for pumps, fans and electric keep-hot	(231) x	=	0.519	=	38.93
Electricity for lighting	(232) x	=	0.519	=	169.75

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Total CO2, kg/year

sum of (265)...(271) =

1133.93

(272)

**TER =**

15.68

(273)

## DER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

Property Address: GT 305 - Be Lean

**Address :** GT 305, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )	(1a) x	Av. Height(m)	(2a) =	Volume(m <sup>3</sup> )
Ground floor	76.4		2.6		198.64
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.4	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.64

### 2. Ventilation rate:

	main heating	+	secondary heating	+	other	=	total	x		m <sup>3</sup> per hour
Number of chimneys	0		0		0		0		x 40 =	0
Number of open flues	0		0		0		0		x 20 =	0
Number of intermittent fans							0		x 10 =	0
Number of passive vents							0		x 10 =	0
Number of flueless gas fires							0		x 40 =	0

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) = <span style="border: 1px solid black; text-align: center;">0</span> (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>		
Number of storeys in the dwelling (ns)		0
Additional infiltration		0
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>		0
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0
If no draught lobby, enter 0.05, else enter 0		0
Percentage of windows and doors draught stripped		0
Window infiltration	$0.25 - [0.2 \times (14) \div 100] =$	0
Infiltration rate	$(8) + (10) + (11) + (12) + (13) + (15) =$	0
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		2
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) <i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>		0.1
Number of sides sheltered		2
Shelter factor	$(20) = 1 - [0.075 \times (19)] =$	0.85
Infiltration rate incorporating shelter factor	$(21) = (18) \times (20) =$	0.08

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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# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1
------	------	-----	------	------	------	------	------	------	------	-----	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (25)

**3. Heat losses and heat loss parameter:**

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			4.47	x1/[1/(1.4)+0.04] =	5.93		(27)
Windows Type 2			2.24	x1/[1/(1.4)+0.04] =	2.97		(27)
Windows Type 3			1.7	x1/[1/(1.4)+0.04] =	2.25		(27)
Windows Type 4			3.28	x1/[1/(1.4)+0.04] =	4.35		(27)
Windows Type 5			2.24	x1/[1/(1.4)+0.04] =	2.97		(27)
Windows Type 6			2.24	x1/[1/(1.4)+0.04] =	2.97		(27)
Walls	61.91	18.41	43.5	x 0.12 =	5.22		(29)
Roof	76.4	0	76.4	x 0.1 =	7.64		(30)
Total area of elements, m <sup>2</sup>			138.31				(31)
Party wall			42.77	x 0 =	0		(32)

\* for windows and roof windows, use effective window U-value calculated using formula 1/[1/U-value+0.04] as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 37.27 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 9.79 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.06 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

## DER WorkSheet: New dwelling design stage

(38)m= 

14.81	14.67	14.53	13.83	13.69	13	13	12.86	13.27	13.69	13.97	14.25
-------	-------	-------	-------	-------	----	----	-------	-------	-------	-------	-------

 (38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m= 

61.86	61.72	61.58	60.89	60.75	60.05	60.05	59.91	60.33	60.75	61.03	61.31
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 Average = Sum(39)<sub>1...12</sub> /12= 

60.85
-------

 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m= 

0.81	0.81	0.81	0.8	0.8	0.79	0.79	0.78	0.79	0.8	0.8	0.8
------	------	------	-----	-----	------	------	------	------	-----	-----	-----

 Average = Sum(40)<sub>1...12</sub> /12= 

0.8
-----

 (40)

Number of days in month (Table 1a)

(41)m= 

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

 (41)

### 4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N 

2.39
------

 (42)  
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)²)] + 0.0013 x (TFA -13.9)  
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 

90.99
-------

 (43)  
 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
100.09	96.45	92.81	89.17	85.53	81.89	81.89	85.53	89.17	92.81	96.45	100.09

 Total = Sum(44)<sub>1...12</sub> = 

1091.84
---------

 (44)  
 Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)  
 (45)m= 

148.42	129.81	133.95	116.78	112.06	96.7	89.6	102.82	104.05	121.26	132.37	143.74
--------	--------	--------	--------	--------	------	------	--------	--------	--------	--------	--------

 Total = Sum(45)<sub>1...12</sub> = 

1431.57
---------

 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m= 

22.26	19.47	20.09	17.52	16.81	14.5	13.44	15.42	15.61	18.19	19.85	21.56
-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------

 (46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 

0
---

 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 

0
---

 (48)

Temperature factor from Table 2b 

0
---

 (49)

Energy lost from water storage, kWh/year (48) x (49) = 

110
-----

 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 

0.02
------

 (51)

If community heating see section 4.3

Volume factor from Table 2a 

1.03
------

 (52)

Temperature factor from Table 2b 

0.6
-----

 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 

1.03
------

 (54)

Enter (50) or (54) in (55) 

1.03
------

 (55)

Water storage loss calculated for each month ((56)m = (55) x (41)m

(56)m= 

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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= 

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (57)

## DER WorkSheet: New dwelling design stage

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m= 

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m= 

203.7	179.74	189.23	170.28	167.33	150.19	144.88	158.1	157.54	176.54	185.86	199.02
-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m= 

203.7	179.74	189.23	170.28	167.33	150.19	144.88	158.1	157.54	176.54	185.86	199.02
-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

Output from water heater (annual)<sub>1...12</sub> 2082.41 (64)

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m= 

93.57	83.1	88.76	81.63	81.48	74.95	74.01	78.41	77.39	84.54	86.81	92.01
-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

### 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

(66)m= 

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	119.55	119.55	119.55	119.55	119.55	119.55	119.55	119.55	119.55	119.55	119.55	119.55

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m= 

18.88	16.77	13.64	10.32	7.72	6.51	7.04	9.15	12.28	15.59	18.2	19.4
-------	-------	-------	-------	------	------	------	------	-------	-------	------	------

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m= 

211.75	213.95	208.41	196.62	181.74	167.76	158.42	156.22	161.76	173.54	188.42	202.41
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m= 

34.96	34.96	34.96	34.96	34.96	34.96	34.96	34.96	34.96	34.96	34.96	34.96
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m= 

-95.64	-95.64	-95.64	-95.64	-95.64	-95.64	-95.64	-95.64	-95.64	-95.64	-95.64	-95.64
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m= 

125.77	123.67	119.3	113.37	109.52	104.09	99.48	105.39	107.49	113.63	120.56	123.68
--------	--------	-------	--------	--------	--------	-------	--------	--------	--------	--------	--------

 (72)

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m= 

415.26	413.25	400.22	379.18	357.84	337.23	323.8	329.62	340.39	361.63	386.05	404.35
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

 (73)

### 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)						
North	0.9x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.77</td></tr></table>	0.77	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>2.24</td></tr></table>	2.24	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>10.63</td></tr></table>	10.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.4</td></tr></table>	0.4	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.8</td></tr></table>	0.8	= <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>10.56</td></tr></table> (74)	10.56
0.77												
2.24												
10.63												
0.4												
0.8												
10.56												
North	0.9x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.77</td></tr></table>	0.77	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>1.7</td></tr></table>	1.7	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>10.63</td></tr></table>	10.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.4</td></tr></table>	0.4	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.8</td></tr></table>	0.8	= <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>4.01</td></tr></table> (74)	4.01
0.77												
1.7												
10.63												
0.4												
0.8												
4.01												

## DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	3.28	x	10.63	x	0.4	x	0.8	=	7.73	(74)
North	0.9x	0.77	x	2.24	x	10.63	x	0.4	x	0.8	=	5.28	(74)
North	0.9x	0.77	x	2.24	x	20.32	x	0.4	x	0.8	=	20.19	(74)
North	0.9x	0.77	x	1.7	x	20.32	x	0.4	x	0.8	=	7.66	(74)
North	0.9x	0.77	x	3.28	x	20.32	x	0.4	x	0.8	=	14.78	(74)
North	0.9x	0.77	x	2.24	x	20.32	x	0.4	x	0.8	=	10.09	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.4	x	0.8	=	34.31	(74)
North	0.9x	0.77	x	1.7	x	34.53	x	0.4	x	0.8	=	13.02	(74)
North	0.9x	0.77	x	3.28	x	34.53	x	0.4	x	0.8	=	25.12	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.4	x	0.8	=	17.15	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.4	x	0.8	=	55.1	(74)
North	0.9x	0.77	x	1.7	x	55.46	x	0.4	x	0.8	=	20.91	(74)
North	0.9x	0.77	x	3.28	x	55.46	x	0.4	x	0.8	=	40.34	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.4	x	0.8	=	27.55	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.4	x	0.8	=	74.23	(74)
North	0.9x	0.77	x	1.7	x	74.72	x	0.4	x	0.8	=	28.17	(74)
North	0.9x	0.77	x	3.28	x	74.72	x	0.4	x	0.8	=	54.35	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.4	x	0.8	=	37.11	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.4	x	0.8	=	79.46	(74)
North	0.9x	0.77	x	1.7	x	79.99	x	0.4	x	0.8	=	30.15	(74)
North	0.9x	0.77	x	3.28	x	79.99	x	0.4	x	0.8	=	58.18	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.4	x	0.8	=	39.73	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.4	x	0.8	=	74.19	(74)
North	0.9x	0.77	x	1.7	x	74.68	x	0.4	x	0.8	=	28.15	(74)
North	0.9x	0.77	x	3.28	x	74.68	x	0.4	x	0.8	=	54.32	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.4	x	0.8	=	37.1	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.4	x	0.8	=	58.86	(74)
North	0.9x	0.77	x	1.7	x	59.25	x	0.4	x	0.8	=	22.34	(74)
North	0.9x	0.77	x	3.28	x	59.25	x	0.4	x	0.8	=	43.09	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.4	x	0.8	=	29.43	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.4	x	0.8	=	41.25	(74)
North	0.9x	0.77	x	1.7	x	41.52	x	0.4	x	0.8	=	15.65	(74)
North	0.9x	0.77	x	3.28	x	41.52	x	0.4	x	0.8	=	30.2	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.4	x	0.8	=	20.62	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.4	x	0.8	=	24.03	(74)
North	0.9x	0.77	x	1.7	x	24.19	x	0.4	x	0.8	=	9.12	(74)
North	0.9x	0.77	x	3.28	x	24.19	x	0.4	x	0.8	=	17.59	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.4	x	0.8	=	12.02	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.4	x	0.8	=	13.03	(74)
North	0.9x	0.77	x	1.7	x	13.12	x	0.4	x	0.8	=	4.95	(74)
North	0.9x	0.77	x	3.28	x	13.12	x	0.4	x	0.8	=	9.54	(74)

## DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	2.24	x	13.12	x	0.4	x	0.8	=	6.52	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.4	x	0.8	=	8.81	(74)
North	0.9x	0.77	x	1.7	x	8.86	x	0.4	x	0.8	=	3.34	(74)
North	0.9x	0.77	x	3.28	x	8.86	x	0.4	x	0.8	=	6.45	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.4	x	0.8	=	4.4	(74)
South	0.9x	0.77	x	4.47	x	46.75	x	0.4	x	0.8	=	46.34	(78)
South	0.9x	0.77	x	2.24	x	46.75	x	0.4	x	0.8	=	23.22	(78)
South	0.9x	0.77	x	4.47	x	76.57	x	0.4	x	0.8	=	75.9	(78)
South	0.9x	0.77	x	2.24	x	76.57	x	0.4	x	0.8	=	38.03	(78)
South	0.9x	0.77	x	4.47	x	97.53	x	0.4	x	0.8	=	96.68	(78)
South	0.9x	0.77	x	2.24	x	97.53	x	0.4	x	0.8	=	48.45	(78)
South	0.9x	0.77	x	4.47	x	110.23	x	0.4	x	0.8	=	109.27	(78)
South	0.9x	0.77	x	2.24	x	110.23	x	0.4	x	0.8	=	54.76	(78)
South	0.9x	0.77	x	4.47	x	114.87	x	0.4	x	0.8	=	113.87	(78)
South	0.9x	0.77	x	2.24	x	114.87	x	0.4	x	0.8	=	57.06	(78)
South	0.9x	0.77	x	4.47	x	110.55	x	0.4	x	0.8	=	109.58	(78)
South	0.9x	0.77	x	2.24	x	110.55	x	0.4	x	0.8	=	54.91	(78)
South	0.9x	0.77	x	4.47	x	108.01	x	0.4	x	0.8	=	107.07	(78)
South	0.9x	0.77	x	2.24	x	108.01	x	0.4	x	0.8	=	53.65	(78)
South	0.9x	0.77	x	4.47	x	104.89	x	0.4	x	0.8	=	103.98	(78)
South	0.9x	0.77	x	2.24	x	104.89	x	0.4	x	0.8	=	52.11	(78)
South	0.9x	0.77	x	4.47	x	101.89	x	0.4	x	0.8	=	101	(78)
South	0.9x	0.77	x	2.24	x	101.89	x	0.4	x	0.8	=	50.61	(78)
South	0.9x	0.77	x	4.47	x	82.59	x	0.4	x	0.8	=	81.86	(78)
South	0.9x	0.77	x	2.24	x	82.59	x	0.4	x	0.8	=	41.02	(78)
South	0.9x	0.77	x	4.47	x	55.42	x	0.4	x	0.8	=	54.93	(78)
South	0.9x	0.77	x	2.24	x	55.42	x	0.4	x	0.8	=	27.53	(78)
South	0.9x	0.77	x	4.47	x	40.4	x	0.4	x	0.8	=	40.05	(78)
South	0.9x	0.77	x	2.24	x	40.4	x	0.4	x	0.8	=	20.07	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	97.16	166.66	234.72	307.94	364.79	372.03	354.48	309.8	259.33	185.65	116.5	83.11	(83)
--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	512.42	579.91	634.94	687.12	722.63	709.26	678.28	639.43	599.72	547.28	502.55	487.47	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.9	0.74	0.54	0.39	0.43	0.68	0.93	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.31	20.45	20.64	20.84	20.96	21	21	21	20.99	20.84	20.54	20.29	(87)
--------	-------	-------	-------	-------	-------	----	----	----	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.24	20.25	20.25	20.26	20.26	20.27	20.27	20.27	20.26	20.26	20.25	20.25	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------



## DER WorkSheet: New dwelling design stage

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.96	0.87	0.7	0.48	0.32	0.36	0.61	0.9	0.98	1	(89)
--------	------	------	------	------	-----	------	------	------	------	-----	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.33	19.52	19.79	20.08	20.23	20.26	20.27	20.27	20.25	20.08	19.66	19.29	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$fLA = \text{Living area} \div (4) =$  0.38 (91)

Mean internal temperature (for the whole dwelling) =  $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.71	19.88	20.11	20.37	20.51	20.54	20.55	20.55	20.53	20.37	20	19.67	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.71	19.88	20.11	20.37	20.51	20.54	20.55	20.55	20.53	20.37	20	19.67	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	------

### 8. Space heating requirement

Set  $T_i$  to the mean internal temperature obtained at step 11 of Table 9b, so that  $T_{i,m}=(76)m$  and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.88	0.71	0.5	0.35	0.39	0.64	0.9	0.98	0.99	(94)
--------	------	------	------	------	------	-----	------	------	------	-----	------	------	------

Useful gains, hmGm ,  $W = (94)m \times (84)m$

(95)m=	508.72	570.28	608.19	604.01	515.31	355.35	236.85	248.22	380.92	495.02	493.67	484.84	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature,  $Lm , W = [(39)m \times [(93)m - (96)m ]$

(97)m=	953.05	924.5	838.44	698.59	535.07	356.92	236.96	248.44	388.06	593.31	787.04	948.54	(97)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, kWh/month =  $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	330.58	238.03	171.31	68.1	14.7	0	0	0	0	73.13	211.23	344.99	
--------	--------	--------	--------	------	------	---	---	---	---	-------	--------	--------	--

$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1...5,9...12} =$  1452.07 (98)

Space heating requirement in kWh/m<sup>2</sup>/year

19.01 (99)

### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

Fraction of heat from Community boilers 1 (303a)

Fraction of total space heat from Community boilers (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.1 (306)

#### Space heating

Annual space heating requirement 1452.07 kWh/year

Space heat from Community boilers (98) x (304a) x (305) x (306) = 1597.27 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0 (308)

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = 0 (309)

## DER WorkSheet: New dwelling design stage

### Water heating

Annual water heating requirement		2082.41
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2290.65 (310a)
Electricity used for heat distribution	0.01 x [(307a)...(307e) + (310a)...(310e)] =	38.88 (313)
Cooling System Energy Efficiency Ratio		0 (314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0 (315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		160.55 (330a)
warm air heating system fans		0 (330b)
pump for solar water heating		0 (330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	160.55 (331)
Energy for lighting (calculated in Appendix L)		333.39 (332)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		95 (367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	= 883.99 (367)
Electrical energy for heat distribution	[(313) x	0.52	= 20.18 (372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)		= 904.17 (373)
CO2 associated with space heating (secondary)	(309) x	0	= 0 (374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	= 0 (375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =		904.17 (376)
CO2 associated with electricity for pumps and fans within dwelling	(331) x	0.52	= 83.33 (378)
CO2 associated with electricity for lighting	(332)) x	0.52	= 173.03 (379)
<b>Total CO2, kg/year</b>	sum of (376)...(382) =		1160.52 (383)
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =		15.19 (384)
<b>EI rating (section 14)</b>			87.19 (385)

## TER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

Property Address: GT 305 - Be Lean

**Address :** GT 305, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	76.4	(1a) x	2.6	(2a) =	198.64 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.4	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	198.64 (5)

### 2. Ventilation rate:

	main heating		secondary heating		other		total		m <sup>3</sup> 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							3	x 10 =	30 (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) =	30	÷ (5) =	0.15 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.4 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.34 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

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
---------	------	------	------	-----	------	------	------	------	---	------	------	------

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.43	0.42	0.37	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4
------	------	------	------	------	------	------	------	------	------	------	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:  (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)  (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =  (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58
------	------	------	------	------	------	------	------	------	------	------	------

(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 

0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58
------	------	------	------	------	------	------	------	------	------	------	------

(25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			<input type="text" value="4.47"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="5.93"/>		(27)
Windows Type 2			<input type="text" value="2.24"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.97"/>		(27)
Windows Type 3			<input type="text" value="1.7"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.25"/>		(27)
Windows Type 4			<input type="text" value="3.28"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="4.35"/>		(27)
Windows Type 5			<input type="text" value="2.24"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.97"/>		(27)
Windows Type 6			<input type="text" value="2.24"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.97"/>		(27)
Walls	<input type="text" value="61.91"/>	<input type="text" value="18.41"/>	<input type="text" value="43.5"/>	$x$ <input type="text" value="0.18"/>	$=$ <input type="text" value="7.83"/>		(29)
Roof	<input type="text" value="76.4"/>	<input type="text" value="0"/>	<input type="text" value="76.4"/>	$x$ <input type="text" value="0.13"/>	$=$ <input type="text" value="9.93"/>		(30)
Total area of elements, m <sup>2</sup>			<input type="text" value="138.31"/>				(31)
Party wall			<input type="text" value="42.77"/>	$x$ <input type="text" value="0"/>	$=$ <input type="text" value="0"/>		(32)

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[1/U\text{-value}+0.04]$  as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) =  (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) =  (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium  (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  (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) =  (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

## TER WorkSheet: New dwelling design stage

(38)m= 

38.97	38.73	38.49	37.38	37.18	36.21	36.21	36.03	36.58	37.18	37.6	38.03
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------

 (38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 

88.4	88.16	87.93	86.82	86.61	85.65	85.65	85.47	86.02	86.61	87.03	87.47
------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Average = Sum(39)<sub>1...12</sub> /12= 

86.82
-------

 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m= 

1.16	1.15	1.15	1.14	1.13	1.12	1.12	1.12	1.13	1.13	1.14	1.14
------	------	------	------	------	------	------	------	------	------	------	------

Average = Sum(40)<sub>1...12</sub> /12= 

1.14
------

 (40)

Number of days in month (Table 1a)

(41)m= 

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

 (41)

**4. Water heating energy requirement: kWh/year:**

Assumed occupancy, N 

2.39
------

 (42)  
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)²)] + 0.0013 x (TFA -13.9)  
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 

90.99
-------

 (43)  
 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
100.09	96.45	92.81	89.17	85.53	81.89	81.89	85.53	89.17	92.81	96.45	100.09

Total = Sum(44)<sub>1...12</sub> = 

1091.84
---------

 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)  
 (45)m= 

148.42	129.81	133.95	116.78	112.06	96.7	89.6	102.82	104.05	121.26	132.37	143.74
--------	--------	--------	--------	--------	------	------	--------	--------	--------	--------	--------

Total = Sum(45)<sub>1...12</sub> = 

1431.57
---------

 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)  
 (46)m= 

22.26	19.47	20.09	17.52	16.81	14.5	13.44	15.42	15.61	18.19	19.85	21.56
-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------

 (46)

Water storage loss:  
 Storage volume (litres) including any solar or WWHRS storage within same vessel 

150
-----

 (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): 

1.39
------

 (48)

Temperature factor from Table 2b 

0.54
------

 (49)

Energy lost from water storage, kWh/year (48) x (49) =

0.75
------

 (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) 

0.75
------

 (55)

Water storage loss calculated for each month ((56)m = (55) x (41)m  
 (56)m= 

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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= 

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (57)

## TER WorkSheet: New dwelling design stage

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m= 

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m= 

195.02	171.9	180.55	161.88	158.65	141.79	136.2	149.42	149.14	167.86	177.46	190.33
--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m= 

195.02	171.9	180.55	161.88	158.65	141.79	136.2	149.42	149.14	167.86	177.46	190.33
--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

Output from water heater (annual)<sub>1...12</sub> 1980.19 (64)

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m= 

86.63	76.83	81.82	74.9	74.54	68.23	67.07	71.46	70.67	77.59	80.08	85.07
-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

### 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

(66)m= 

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	119.55	119.55	119.55	119.55	119.55	119.55	119.55	119.55	119.55	119.55	119.55	119.55

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m= 

18.88	16.77	13.64	10.32	7.72	6.51	7.04	9.15	12.28	15.59	18.2	19.4
-------	-------	-------	-------	------	------	------	------	-------	-------	------	------

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m= 

211.75	213.95	208.41	196.62	181.74	167.76	158.42	156.22	161.76	173.54	188.42	202.41
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m= 

34.96	34.96	34.96	34.96	34.96	34.96	34.96	34.96	34.96	34.96	34.96	34.96
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m= 

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m= 

-95.64	-95.64	-95.64	-95.64	-95.64	-95.64	-95.64	-95.64	-95.64	-95.64	-95.64	-95.64
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m= 

116.43	114.33	109.97	104.03	100.18	94.76	90.15	96.05	98.15	104.29	111.23	114.34
--------	--------	--------	--------	--------	-------	-------	-------	-------	--------	--------	--------

 (72)

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m= 

408.93	406.91	393.88	372.85	351.51	330.9	317.47	323.29	334.06	355.3	379.72	398.02
--------	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	--------

 (73)

### 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub>g</sub> Table 6b	FF Table 6c	Gains (W)						
North	0.9x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.77</td></tr></table>	0.77	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>2.24</td></tr></table>	2.24	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>10.63</td></tr></table>	10.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.63</td></tr></table>	0.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.7</td></tr></table>	0.7	= <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>14.56</td></tr></table> (74)	14.56
0.77												
2.24												
10.63												
0.63												
0.7												
14.56												
North	0.9x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.77</td></tr></table>	0.77	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>1.7</td></tr></table>	1.7	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>10.63</td></tr></table>	10.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.63</td></tr></table>	0.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.7</td></tr></table>	0.7	= <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>5.52</td></tr></table> (74)	5.52
0.77												
1.7												
10.63												
0.63												
0.7												
5.52												

## TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	3.28	x	10.63	x	0.63	x	0.7	=	10.66	(74)
North	0.9x	0.77	x	2.24	x	10.63	x	0.63	x	0.7	=	7.28	(74)
North	0.9x	0.77	x	2.24	x	20.32	x	0.63	x	0.7	=	27.82	(74)
North	0.9x	0.77	x	1.7	x	20.32	x	0.63	x	0.7	=	10.56	(74)
North	0.9x	0.77	x	3.28	x	20.32	x	0.63	x	0.7	=	20.37	(74)
North	0.9x	0.77	x	2.24	x	20.32	x	0.63	x	0.7	=	13.91	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.63	x	0.7	=	47.28	(74)
North	0.9x	0.77	x	1.7	x	34.53	x	0.63	x	0.7	=	17.94	(74)
North	0.9x	0.77	x	3.28	x	34.53	x	0.63	x	0.7	=	34.61	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.63	x	0.7	=	23.64	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.63	x	0.7	=	75.94	(74)
North	0.9x	0.77	x	1.7	x	55.46	x	0.63	x	0.7	=	28.82	(74)
North	0.9x	0.77	x	3.28	x	55.46	x	0.63	x	0.7	=	55.6	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.63	x	0.7	=	37.97	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.63	x	0.7	=	102.3	(74)
North	0.9x	0.77	x	1.7	x	74.72	x	0.63	x	0.7	=	38.82	(74)
North	0.9x	0.77	x	3.28	x	74.72	x	0.63	x	0.7	=	74.9	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.63	x	0.7	=	51.15	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.63	x	0.7	=	109.51	(74)
North	0.9x	0.77	x	1.7	x	79.99	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	3.28	x	79.99	x	0.63	x	0.7	=	80.18	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.63	x	0.7	=	54.76	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.63	x	0.7	=	102.24	(74)
North	0.9x	0.77	x	1.7	x	74.68	x	0.63	x	0.7	=	38.8	(74)
North	0.9x	0.77	x	3.28	x	74.68	x	0.63	x	0.7	=	74.86	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.63	x	0.7	=	51.12	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.63	x	0.7	=	81.12	(74)
North	0.9x	0.77	x	1.7	x	59.25	x	0.63	x	0.7	=	30.78	(74)
North	0.9x	0.77	x	3.28	x	59.25	x	0.63	x	0.7	=	59.39	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.63	x	0.7	=	40.56	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.63	x	0.7	=	56.84	(74)
North	0.9x	0.77	x	1.7	x	41.52	x	0.63	x	0.7	=	21.57	(74)
North	0.9x	0.77	x	3.28	x	41.52	x	0.63	x	0.7	=	41.62	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.63	x	0.7	=	28.42	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.63	x	0.7	=	33.12	(74)
North	0.9x	0.77	x	1.7	x	24.19	x	0.63	x	0.7	=	12.57	(74)
North	0.9x	0.77	x	3.28	x	24.19	x	0.63	x	0.7	=	24.25	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.63	x	0.7	=	16.56	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.63	x	0.7	=	17.96	(74)
North	0.9x	0.77	x	1.7	x	13.12	x	0.63	x	0.7	=	6.82	(74)
North	0.9x	0.77	x	3.28	x	13.12	x	0.63	x	0.7	=	13.15	(74)

## TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	2.24	x	13.12	x	0.63	x	0.7	=	8.98	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.63	x	0.7	=	12.14	(74)
North	0.9x	0.77	x	1.7	x	8.86	x	0.63	x	0.7	=	4.61	(74)
North	0.9x	0.77	x	3.28	x	8.86	x	0.63	x	0.7	=	8.89	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.63	x	0.7	=	6.07	(74)
South	0.9x	0.77	x	4.47	x	46.75	x	0.63	x	0.7	=	63.87	(78)
South	0.9x	0.77	x	2.24	x	46.75	x	0.63	x	0.7	=	32.01	(78)
South	0.9x	0.77	x	4.47	x	76.57	x	0.63	x	0.7	=	104.6	(78)
South	0.9x	0.77	x	2.24	x	76.57	x	0.63	x	0.7	=	52.42	(78)
South	0.9x	0.77	x	4.47	x	97.53	x	0.63	x	0.7	=	133.24	(78)
South	0.9x	0.77	x	2.24	x	97.53	x	0.63	x	0.7	=	66.77	(78)
South	0.9x	0.77	x	4.47	x	110.23	x	0.63	x	0.7	=	150.59	(78)
South	0.9x	0.77	x	2.24	x	110.23	x	0.63	x	0.7	=	75.46	(78)
South	0.9x	0.77	x	4.47	x	114.87	x	0.63	x	0.7	=	156.92	(78)
South	0.9x	0.77	x	2.24	x	114.87	x	0.63	x	0.7	=	78.64	(78)
South	0.9x	0.77	x	4.47	x	110.55	x	0.63	x	0.7	=	151.02	(78)
South	0.9x	0.77	x	2.24	x	110.55	x	0.63	x	0.7	=	75.68	(78)
South	0.9x	0.77	x	4.47	x	108.01	x	0.63	x	0.7	=	147.55	(78)
South	0.9x	0.77	x	2.24	x	108.01	x	0.63	x	0.7	=	73.94	(78)
South	0.9x	0.77	x	4.47	x	104.89	x	0.63	x	0.7	=	143.3	(78)
South	0.9x	0.77	x	2.24	x	104.89	x	0.63	x	0.7	=	71.81	(78)
South	0.9x	0.77	x	4.47	x	101.89	x	0.63	x	0.7	=	139.18	(78)
South	0.9x	0.77	x	2.24	x	101.89	x	0.63	x	0.7	=	69.75	(78)
South	0.9x	0.77	x	4.47	x	82.59	x	0.63	x	0.7	=	112.82	(78)
South	0.9x	0.77	x	2.24	x	82.59	x	0.63	x	0.7	=	56.54	(78)
South	0.9x	0.77	x	4.47	x	55.42	x	0.63	x	0.7	=	75.7	(78)
South	0.9x	0.77	x	2.24	x	55.42	x	0.63	x	0.7	=	37.94	(78)
South	0.9x	0.77	x	4.47	x	40.4	x	0.63	x	0.7	=	55.19	(78)
South	0.9x	0.77	x	2.24	x	40.4	x	0.63	x	0.7	=	27.66	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	133.89	229.68	323.48	424.38	502.72	512.7	488.51	426.95	357.38	255.85	160.55	114.54	(83)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	542.82	636.59	717.36	797.22	854.23	843.59	805.98	750.24	691.44	611.15	540.27	512.56	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.93	0.81	0.62	0.46	0.51	0.77	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.85	20.03	20.29	20.62	20.86	20.97	20.99	20.99	20.92	20.61	20.17	19.82	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.95	19.96	19.96	19.97	19.97	19.98	19.98	19.99	19.98	19.97	19.97	19.96	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------



## TER WorkSheet: New dwelling design stage

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.9	0.75	0.54	0.36	0.41	0.68	0.93	0.99	1	(89)
--------	------	------	------	-----	------	------	------	------	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.44	18.7	19.08	19.54	19.84	19.97	19.98	19.98	19.92	19.53	18.91	18.4	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

$fLA = \text{Living area} \div (4) =$  0.38 (91)

Mean internal temperature (for the whole dwelling) =  $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	18.98	19.21	19.54	19.95	20.23	20.35	20.37	20.37	20.3	19.94	19.39	18.94	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.98	19.21	19.54	19.95	20.23	20.35	20.37	20.37	20.3	19.94	19.39	18.94	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

### 8. Space heating requirement

Set  $T_i$  to the mean internal temperature obtained at step 11 of Table 9b, so that  $T_{i,m}=(76)m$  and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.9	0.77	0.57	0.4	0.45	0.71	0.93	0.98	0.99	(94)
--------	------	------	------	-----	------	------	-----	------	------	------	------	------	------

Useful gains, hmGm ,  $W = (94)m \times (84)m$

(95)m=	538.76	626.18	690.29	719.19	657.54	479.07	321.04	335.98	492.88	567.3	531.72	509.6	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	-------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature,  $Lm , W = [(93)m - (96)m]$

(97)m=	1297.53	1261.44	1146.73	959.23	739	492.54	322.82	339.15	533.65	809.22	1069.77	1289.54	(97)
--------	---------	---------	---------	--------	-----	--------	--------	--------	--------	--------	---------	---------	------

Space heating requirement for each month, kWh/month =  $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	564.53	426.89	339.59	172.83	60.6	0	0	0	0	179.99	387.4	580.27	
--------	--------	--------	--------	--------	------	---	---	---	---	--------	-------	--------	--

$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1...5,9...12} =$  2712.1 (98)

Space heating requirement in kWh/m<sup>2</sup>/year

35.5 (99)

### 9a. Energy requirements – Individual heating systems including micro-CHP)

#### Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s)  $(202) = 1 - (201) =$  1 (202)

Fraction of total heating from main system 1  $(204) = (202) \times [1 - (203)] =$  1 (204)

Efficiency of main space heating system 1 93.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

564.53	426.89	339.59	172.83	60.6	0	0	0	0	179.99	387.4	580.27
--------	--------	--------	--------	------	---	---	---	---	--------	-------	--------

(211)m =  $\{[(98)m \times (204)]\} \times 100 \div (206)$  (211)

603.77	456.57	363.2	184.85	64.82	0	0	0	0	192.5	414.33	620.61
--------	--------	-------	--------	-------	---	---	---	---	-------	--------	--------

$\text{Total (kWh/year)} = \text{Sum}(211)_{1...5,10...12} =$  2900.64 (211)

Space heating fuel (secondary), kWh/month

=  $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
---------	---	---	---	---	---	---	---	---	---	---	---	--

$\text{Total (kWh/year)} = \text{Sum}(215)_{1...5,10...12} =$  0 (215)

# TER WorkSheet: New dwelling design stage

## Water heating

Output from water heater (calculated above)

195.02	171.9	180.55	161.88	158.65	141.79	136.2	149.42	149.14	167.86	177.46	190.33
--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

Efficiency of water heater

79.8 (216)

(217)m= 87.49 87.15 86.48 84.99 82.5 79.8 79.8 79.8 79.8 85 86.84 87.6 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=

222.91	197.25	208.79	190.47	192.32	177.68	170.68	187.24	186.89	197.48	204.35	217.28
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(219a)<sub>1..12</sub> =

2353.32 (219)

## Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2900.64

Water heating fuel used

2353.32

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

333.39

(232)

## 12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	= 626.54 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 508.32 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1134.86 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 38.93 (267)
Electricity for lighting	(232) x	0.519	= 173.03 (268)
Total CO2, kg/year		sum of (265)...(271) =	1346.81 (272)

**TER =** 17.63 (273)

## DER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

Property Address: GT 306 - Be Lean

**Address :** GT 306, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	75.8	(1a) ×	2.6	(2a) =	197.08
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75.8	(4)			
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =				197.08

### 2. Ventilation rate:

	main heating		secondary heating		other		total		m <sup>3</sup> per hour
Number of chimneys	0	+	0	+	0	=	0	× 40 =	0
Number of open flues	0	+	0	+	0	=	0	× 20 =	0
Number of intermittent fans							0	× 10 =	0
Number of passive vents							0	× 10 =	0
Number of flueless gas fires							0	× 40 =	0

#### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 0 ÷ (5) = 0 (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 0 [(9)-1]×0.1 = (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  $0.25 - [0.2 \times (14) \div 100] =$  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 2 (17)

If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) 0.1 (18)

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

Number of sides sheltered 1 (19)

Shelter factor  $(20) = 1 - [0.075 \times (19)] =$  0.92 (20)

Infiltration rate incorporating shelter factor  $(21) = (18) \times (20) =$  0.09 (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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# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.12	0.12	0.11	0.1	0.1	0.09	0.09	0.09	0.09	0.1	0.1	0.11
------	------	------	-----	-----	------	------	------	------	-----	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 

0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.2	0.21	0.22	0.22	0.23
------	------	------	------	------	------	------	-----	------	------	------	------

 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 

0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.2	0.21	0.22	0.22	0.23
------	------	------	------	------	------	------	-----	------	------	------	------

 (25)

**3. Heat losses and heat loss parameter:**

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			2.47	$\times 1/[1/(1.4)+0.04] =$	3.27		(27)
Windows Type 2			2.24	$\times 1/[1/(1.4)+0.04] =$	2.97		(27)
Windows Type 3			2.24	$\times 1/[1/(1.4)+0.04] =$	2.97		(27)
Windows Type 4			6.73	$\times 1/[1/(1.4)+0.04] =$	8.92		(27)
Windows Type 5			2.24	$\times 1/[1/(1.4)+0.04] =$	2.97		(27)
Windows Type 6			2.24	$\times 1/[1/(1.4)+0.04] =$	2.97		(27)
Windows Type 7			1.5	$\times 1/[1/(1.4)+0.04] =$	1.99		(27)
Walls	80.34	19.66	60.68	$\times 0.12 =$	7.28		(29)
Roof	75.8	0	75.8	$\times 0.1 =$	7.58		(30)
Total area of elements, m <sup>2</sup>			156.14				(31)
Party wall			27.72	$\times 0 =$	0		(32)

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[1/(U\text{-value})+0.04]$  as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 40.93 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 11.01 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 51.93 (37)

## DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly

$$(38)m = 0.33 \times (25)m \times (5)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	15.31	15.16	15.01	14.26	14.11	13.36	13.36	13.21	13.66	14.11	14.41	14.71	(38)

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

(39)m=	67.25	67.1	66.95	66.19	66.04	65.29	65.29	65.14	65.59	66.04	66.34	66.64	
Average = Sum(39) <sub>1...12</sub> / 12 =												66.16	(39)

Heat loss parameter (HLP), W/m<sup>2</sup>K

$$(40)m = (39)m \div (4)$$

(40)m=	0.89	0.89	0.88	0.87	0.87	0.86	0.86	0.86	0.87	0.87	0.88	0.88	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.87	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

### 4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.38

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)<sup>2</sup>)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

90.69

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	99.75	96.13	92.5	88.87	85.24	81.62	81.62	85.24	88.87	92.5	96.13	99.75	
Total = Sum(44) <sub>1...12</sub> =												1088.23	(44)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

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=	147.93	129.38	133.51	116.4	111.69	96.38	89.31	102.48	103.71	120.86	131.93	143.26	
Total = Sum(45) <sub>1...12</sub> =												1426.84	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.19	19.41	20.03	17.46	16.75	14.46	13.4	15.37	15.56	18.13	19.79	21.49	(46)
--------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

110

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0.02

(51)

If community heating see section 4.3

Volume factor from Table 2a

1.03

(52)

Temperature factor from Table 2b

0.6

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

1.03

(54)

Enter (50) or (54) in (55)

1.03

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

# DER WorkSheet: New dwelling design stage

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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	203.21	179.31	188.79	169.89	166.96	149.87	144.58	157.76	157.2	176.14	185.42	198.54	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	203.21	179.31	188.79	169.89	166.96	149.87	144.58	157.76	157.2	176.14	185.42	198.54			
												Output from water heater (annual) <sub>1...12</sub>		2077.68	(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=	93.41	82.96	88.61	81.5	81.36	74.84	73.92	78.3	77.28	84.41	86.66	91.86	(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=	118.92	118.92	118.92	118.92	118.92	118.92	118.92	118.92	118.92	118.92	118.92	118.92	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.76	16.66	13.55	10.26	7.67	6.47	7	9.09	12.21	15.5	18.09	19.28	(67)
--------	-------	-------	-------	-------	------	------	---	------	-------	------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	210.44	212.62	207.12	195.41	180.62	166.72	157.43	155.25	160.75	172.47	187.26	201.15	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.89	34.89	34.89	34.89	34.89	34.89	34.89	34.89	34.89	34.89	34.89	34.89	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-95.13	-95.13	-95.13	-95.13	-95.13	-95.13	-95.13	-95.13	-95.13	-95.13	-95.13	-95.13	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	125.55	123.45	119.1	113.19	109.35	103.95	99.35	105.24	107.33	113.45	120.36	123.46	(72)
--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	413.43	411.42	398.45	377.53	356.31	335.81	322.45	328.26	338.96	360.09	384.38	402.58	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
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## DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	2.47	x	10.63	x	0.4	x	0.8	=	5.82	(74)
North	0.9x	0.77	x	2.24	x	10.63	x	0.4	x	0.8	=	5.28	(74)
North	0.9x	0.77	x	2.24	x	10.63	x	0.4	x	0.8	=	5.28	(74)
North	0.9x	0.77	x	6.73	x	10.63	x	0.4	x	0.8	=	15.87	(74)
North	0.9x	0.77	x	2.24	x	10.63	x	0.4	x	0.8	=	5.28	(74)
North	0.9x	0.77	x	2.47	x	20.32	x	0.4	x	0.8	=	11.13	(74)
North	0.9x	0.77	x	2.24	x	20.32	x	0.4	x	0.8	=	10.09	(74)
North	0.9x	0.77	x	2.24	x	20.32	x	0.4	x	0.8	=	10.09	(74)
North	0.9x	0.77	x	6.73	x	20.32	x	0.4	x	0.8	=	30.33	(74)
North	0.9x	0.77	x	2.24	x	20.32	x	0.4	x	0.8	=	10.09	(74)
North	0.9x	0.77	x	2.47	x	34.53	x	0.4	x	0.8	=	18.91	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.4	x	0.8	=	17.15	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.4	x	0.8	=	17.15	(74)
North	0.9x	0.77	x	6.73	x	34.53	x	0.4	x	0.8	=	51.53	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.4	x	0.8	=	17.15	(74)
North	0.9x	0.77	x	2.47	x	55.46	x	0.4	x	0.8	=	30.38	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.4	x	0.8	=	27.55	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.4	x	0.8	=	27.55	(74)
North	0.9x	0.77	x	6.73	x	55.46	x	0.4	x	0.8	=	82.78	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.4	x	0.8	=	27.55	(74)
North	0.9x	0.77	x	2.47	x	74.72	x	0.4	x	0.8	=	40.93	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.4	x	0.8	=	37.11	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.4	x	0.8	=	37.11	(74)
North	0.9x	0.77	x	6.73	x	74.72	x	0.4	x	0.8	=	111.51	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.4	x	0.8	=	37.11	(74)
North	0.9x	0.77	x	2.47	x	79.99	x	0.4	x	0.8	=	43.81	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.4	x	0.8	=	39.73	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.4	x	0.8	=	39.73	(74)
North	0.9x	0.77	x	6.73	x	79.99	x	0.4	x	0.8	=	119.37	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.4	x	0.8	=	39.73	(74)
North	0.9x	0.77	x	2.47	x	74.68	x	0.4	x	0.8	=	40.9	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.4	x	0.8	=	37.1	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.4	x	0.8	=	37.1	(74)
North	0.9x	0.77	x	6.73	x	74.68	x	0.4	x	0.8	=	111.45	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.4	x	0.8	=	37.1	(74)
North	0.9x	0.77	x	2.47	x	59.25	x	0.4	x	0.8	=	32.45	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.4	x	0.8	=	29.43	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.4	x	0.8	=	29.43	(74)
North	0.9x	0.77	x	6.73	x	59.25	x	0.4	x	0.8	=	88.42	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.4	x	0.8	=	29.43	(74)
North	0.9x	0.77	x	2.47	x	41.52	x	0.4	x	0.8	=	22.74	(74)

## DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	2.24	x	41.52	x	0.4	x	0.8	=	20.62	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.4	x	0.8	=	20.62	(74)
North	0.9x	0.77	x	6.73	x	41.52	x	0.4	x	0.8	=	61.96	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.4	x	0.8	=	20.62	(74)
North	0.9x	0.77	x	2.47	x	24.19	x	0.4	x	0.8	=	13.25	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.4	x	0.8	=	12.02	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.4	x	0.8	=	12.02	(74)
North	0.9x	0.77	x	6.73	x	24.19	x	0.4	x	0.8	=	36.1	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.4	x	0.8	=	12.02	(74)
North	0.9x	0.77	x	2.47	x	13.12	x	0.4	x	0.8	=	7.19	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.4	x	0.8	=	6.52	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.4	x	0.8	=	6.52	(74)
North	0.9x	0.77	x	6.73	x	13.12	x	0.4	x	0.8	=	19.58	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.4	x	0.8	=	6.52	(74)
North	0.9x	0.77	x	2.47	x	8.86	x	0.4	x	0.8	=	4.86	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.4	x	0.8	=	4.4	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.4	x	0.8	=	4.4	(74)
North	0.9x	0.77	x	6.73	x	8.86	x	0.4	x	0.8	=	13.23	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.4	x	0.8	=	4.4	(74)
East	0.9x	0.77	x	2.24	x	19.64	x	0.4	x	0.8	=	9.76	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.4	x	0.8	=	19.09	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.4	x	0.8	=	31.43	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.4	x	0.8	=	45.84	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.4	x	0.8	=	56.18	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.4	x	0.8	=	57.51	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.4	x	0.8	=	54.75	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.4	x	0.8	=	47.03	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.4	x	0.8	=	36.55	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.4	x	0.8	=	22.65	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.4	x	0.8	=	12.16	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.4	x	0.8	=	8.02	(76)
South	0.9x	0.77	x	1.5	x	46.75	x	0.4	x	0.8	=	15.55	(78)
South	0.9x	0.77	x	1.5	x	76.57	x	0.4	x	0.8	=	25.47	(78)
South	0.9x	0.77	x	1.5	x	97.53	x	0.4	x	0.8	=	32.44	(78)
South	0.9x	0.77	x	1.5	x	110.23	x	0.4	x	0.8	=	36.67	(78)
South	0.9x	0.77	x	1.5	x	114.87	x	0.4	x	0.8	=	38.21	(78)
South	0.9x	0.77	x	1.5	x	110.55	x	0.4	x	0.8	=	36.77	(78)
South	0.9x	0.77	x	1.5	x	108.01	x	0.4	x	0.8	=	35.93	(78)
South	0.9x	0.77	x	1.5	x	104.89	x	0.4	x	0.8	=	34.89	(78)
South	0.9x	0.77	x	1.5	x	101.89	x	0.4	x	0.8	=	33.89	(78)
South	0.9x	0.77	x	1.5	x	82.59	x	0.4	x	0.8	=	27.47	(78)



## DER WorkSheet: New dwelling design stage

South  $0.9 \times \boxed{0.77} \times \boxed{1.5} \times \boxed{55.42} \times \boxed{0.4} \times \boxed{0.8} = \boxed{18.43}$  (78)

South  $0.9 \times \boxed{0.77} \times \boxed{1.5} \times \boxed{40.4} \times \boxed{0.4} \times \boxed{0.8} = \boxed{13.44}$  (78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	62.85	116.3	185.78	278.32	358.17	376.66	354.32	291.09	217.02	135.52	76.91	52.76	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	476.27	527.71	584.23	655.85	714.48	712.48	676.77	619.34	555.98	495.61	461.29	455.33	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 

21
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 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.93	0.79	0.58	0.42	0.48	0.76	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.16	20.28	20.48	20.75	20.94	20.99	21	21	20.96	20.73	20.39	20.13	(87)
--------	-------	-------	-------	-------	-------	-------	----	----	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.18	20.18	20.18	20.19	20.19	20.2	20.2	20.2	20.2	20.19	20.19	20.19	(88)
--------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.91	0.74	0.51	0.35	0.4	0.69	0.94	0.99	1	(89)
--------	---	------	------	------	------	------	------	-----	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.05	19.22	19.52	19.91	20.13	20.2	20.2	20.2	20.17	19.88	19.4	19.02	(90)
--------	-------	-------	-------	-------	-------	------	------	------	-------	-------	------	-------	------

fLA = Living area ÷ (4) = 

0.39
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 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.48	19.63	19.9	20.24	20.44	20.51	20.51	20.51	20.48	20.21	19.79	19.45	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.48	19.63	19.9	20.24	20.44	20.51	20.51	20.51	20.48	20.21	19.79	19.45	(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=	1	0.99	0.97	0.91	0.76	0.54	0.38	0.43	0.72	0.94	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	474.05	522.73	569.55	599.33	540.91	382.02	255.04	267.1	398.88	468.31	456.49	453.69	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(93)m – (96)m ]

(97)m=	1020.76	988.56	896.89	750.35	577.51	385.59	255.36	267.82	418.28	634.44	841.85	1016.48	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	406.75	313.03	243.55	108.73	27.23	0	0	0	0	123.6	277.46	418.72	(98)
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Total per year (kWh/year) = Sum(98)...5,9...12 = 

1919.07
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 (98)

Space heating requirement in kWh/m<sup>2</sup>/year 

25.32
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 (99)

### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

## DER WorkSheet: New dwelling design stage

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)
<i>The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.</i>		
Fraction of heat from Community boilers	1	(303a)
Fraction of total space heat from Community boilers <span style="float: right;">(302) x (303a) =</span>	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system	1	(305)
Distribution loss factor (Table 12c) for community heating system	1.1	(306)
<b>Space heating</b>		
<b>kWh/year</b>		
Annual space heating requirement	1919.07	
Space heat from Community boilers <span style="float: right;">(98) x (304a) x (305) x (306) =</span>	2110.98	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0	(308)
Space heating requirement from secondary/supplementary system <span style="float: right;">(98) x (301) x 100 ÷ (308) =</span>	0	(309)
<b>Water heating</b>		
Annual water heating requirement	2077.68	
If DHW from community scheme: Water heat from Community boilers <span style="float: right;">(64) x (303a) x (305) x (306) =</span>	2285.45	(310a)
Electricity used for heat distribution <span style="float: right;">0.01 x [(307a)...(307e) + (310a)...(310e)] =</span>	43.96	(313)
Cooling System Energy Efficiency Ratio	0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0) <span style="float: right;">= (107) ÷ (314) =</span>	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	159.29	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year <span style="float: right;">=(330a) + (330b) + (330g) =</span>	159.29	(331)
Energy for lighting (calculated in Appendix L)	331.32	(332)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)				
Efficiency of heat source 1 (%) <span style="float: right;"><i>If there is CHP using two fuels repeat (363) to (366) for the second fuel</i></span>			95	(367a)
CO2 associated with heat source 1 <span style="float: right;">[(307b)+(310b)] x 100 ÷ (367b) x</span>		0.22	=	999.61 (367)
Electrical energy for heat distribution <span style="float: right;">[(313) x</span>		0.52	=	22.82 (372)
Total CO2 associated with community systems <span style="float: right;">(363)...(366) + (368)...(372)</span>			=	1022.43 (373)
CO2 associated with space heating (secondary) <span style="float: right;">(309) x</span>		0	=	0 (374)
CO2 associated with water from immersion heater or instantaneous heater <span style="float: right;">(312) x</span>		0.22	=	0 (375)
Total CO2 associated with space and water heating <span style="float: right;">(373) + (374) + (375) =</span>				1022.43 (376)
CO2 associated with electricity for pumps and fans within dwelling <span style="float: right;">(331) x</span>		0.52	=	82.67 (378)

## DER WorkSheet: New dwelling design stage

CO2 associated with electricity for lighting	(332)) x	0.52	=	171.96	(379)
<b>Total CO2, kg/year</b>	sum of (376)...(382) =			1277.05	(383)
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =			16.85	(384)
<b>EI rating (section 14)</b>				85.83	(385)

# TER WorkSheet: New dwelling design stage

## User Details:

**Assessor Name:** John Simpson  
**Software Name:** Stroma FSAP 2012

**Stroma Number:** STRO006273  
**Software Version:** Version: 1.0.5.8

## Property Address: GT 306 - Be Lean

**Address :** GT 306, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )	Av. Height(m)	Volume(m <sup>3</sup> )
Ground floor	<input type="text" value="75.8"/> (1a)	<input type="text" value="2.6"/> (2a)	<input type="text" value="197.08"/> (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	<input type="text" value="75.8"/> (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	<input type="text" value="197.08"/> (5)

### 2. Ventilation rate:

	main heating	secondary heating	other	total	m <sup>3</sup> per hour
Number of chimneys	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/> (6a)
Number of open flues	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/> (6b)
Number of intermittent fans				<input type="text" value="3"/>	<input type="text" value="30"/> (7a)
Number of passive vents				<input type="text" value="0"/>	<input type="text" value="0"/> (7b)
Number of flueless gas fires				<input type="text" value="0"/>	<input type="text" value="0"/> (7c)

### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	<input type="text" value="30"/>	÷ (5) =	<input type="text" value="0.15"/> (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			<input type="text" value="0"/> (9)
Additional infiltration		[(9)-1]x0.1 =	<input type="text" value="0"/> (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			<input type="text" value="0"/> (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			<input type="text" value="0"/> (12)
If no draught lobby, enter 0.05, else enter 0			<input type="text" value="0"/> (13)
Percentage of windows and doors draught stripped			<input type="text" value="0"/> (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		<input type="text" value="0"/> (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		<input type="text" value="0"/> (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			<input type="text" value="5"/> (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			<input type="text" value="0.4"/> (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			<input type="text" value="1"/> (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		<input type="text" value="0.92"/> (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		<input type="text" value="0.37"/> (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	<input type="text" value="5.1"/>	<input type="text" value="5"/>	<input type="text" value="4.9"/>	<input type="text" value="4.4"/>	<input type="text" value="4.3"/>	<input type="text" value="3.8"/>	<input type="text" value="3.8"/>	<input type="text" value="3.7"/>	<input type="text" value="4"/>	<input type="text" value="4.3"/>	<input type="text" value="4.5"/>	<input type="text" value="4.7"/>
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	<input type="text" value="1.27"/>	<input type="text" value="1.25"/>	<input type="text" value="1.23"/>	<input type="text" value="1.1"/>	<input type="text" value="1.08"/>	<input type="text" value="0.95"/>	<input type="text" value="0.95"/>	<input type="text" value="0.92"/>	<input type="text" value="1"/>	<input type="text" value="1.08"/>	<input type="text" value="1.12"/>	<input type="text" value="1.18"/>
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# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.47	0.46	0.41	0.4	0.35	0.35	0.34	0.37	0.4	0.42	0.44
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 

0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.6
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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 

0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.6
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 (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			2.38	$\times 1/[1/(1.4)+0.04] =$	3.16		(27)
Windows Type 2			2.16	$\times 1/[1/(1.4)+0.04] =$	2.86		(27)
Windows Type 3			2.16	$\times 1/[1/(1.4)+0.04] =$	2.86		(27)
Windows Type 4			6.49	$\times 1/[1/(1.4)+0.04] =$	8.6		(27)
Windows Type 5			2.16	$\times 1/[1/(1.4)+0.04] =$	2.86		(27)
Windows Type 6			2.16	$\times 1/[1/(1.4)+0.04] =$	2.86		(27)
Windows Type 7			1.45	$\times 1/[1/(1.4)+0.04] =$	1.92		(27)
Walls	80.34	18.96	61.38	$\times 0.18 =$	11.05		(29)
Roof	75.8	0	75.8	$\times 0.13 =$	9.85		(30)
Total area of elements, m²			156.14				(31)
Party wall			27.72	$\times 0 =$	0		(32)

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[1/(U\text{-value})+0.04]$  as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 46.04 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 8.6 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 54.63 (37)

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Ventilation heat loss calculated monthly

(38)m = 0.33 × (25)m × (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	39.84	39.55	39.27	37.96	37.72	36.58	36.58	36.37	37.02	37.72	38.22	38.73	(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=	94.47	94.19	93.91	92.6	92.35	91.21	91.21	91	91.65	92.35	92.85	93.37	
Average = Sum(39) <sub>1...12</sub> /12=												92.6	(39)

Heat loss parameter (HLP), W/m<sup>2</sup>K

(40)m = (39)m ÷ (4)

(40)m=	1.25	1.24	1.24	1.22	1.22	1.2	1.2	1.2	1.21	1.22	1.22	1.23	
Average = Sum(40) <sub>1...12</sub> /12=												1.22	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

**4. Water heating energy requirement: kWh/year:**

Assumed occupancy, N 2.38 (42)  
 if TFA > 13.9, N = 1 + 1.76 × [1 - exp(-0.000349 × (TFA - 13.9)<sup>2</sup>)] + 0.0013 × (TFA - 13.9)  
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 × N) + 36 90.69 (43)  
 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	99.75	96.13	92.5	88.87	85.24	81.62	81.62	85.24	88.87	92.5	96.13	99.75	
Total = Sum(44) <sub>1...12</sub> =												1088.23	(44)

Energy content of hot water used - calculated monthly = 4.190 × Vd,m × nm × DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	147.93	129.38	133.51	116.4	111.69	96.38	89.31	102.48	103.71	120.86	131.93	143.26	
Total = Sum(45) <sub>1...12</sub> =												1426.84	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.19	19.41	20.03	17.46	16.75	14.46	13.4	15.37	15.56	18.13	19.79	21.49	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) × (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) × (51) × (52) × (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)
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# TER WorkSheet: New dwelling design stage

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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.53	171.47	180.11	161.49	158.28	141.47	135.9	149.08	148.8	167.45	177.02	189.86	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	194.53	171.47	180.11	161.49	158.28	141.47	135.9	149.08	148.8	167.45	177.02	189.86	
Output from water heater (annual) <sub>1...12</sub>												1975.46	

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	86.46	76.69	81.67	74.78	74.41	68.12	66.97	71.35	70.56	77.46	79.94	84.91	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	118.92	118.92	118.92	118.92	118.92	118.92	118.92	118.92	118.92	118.92	118.92	118.92	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.76	16.66	13.55	10.26	7.67	6.47	7	9.09	12.21	15.5	18.09	19.28	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	210.44	212.62	207.12	195.41	180.62	166.72	157.43	155.25	160.75	172.47	187.26	201.15	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.89	34.89	34.89	34.89	34.89	34.89	34.89	34.89	34.89	34.89	34.89	34.89	(69)
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Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-95.13	-95.13	-95.13	-95.13	-95.13	-95.13	-95.13	-95.13	-95.13	-95.13	-95.13	-95.13	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	116.21	114.12	109.77	103.86	100.02	94.61	90.01	95.9	97.99	104.12	111.03	114.13	(72)
--------	--------	--------	--------	--------	--------	-------	-------	------	-------	--------	--------	--------	------

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	407.09	405.08	392.12	371.2	349.98	329.48	316.12	321.92	332.63	353.76	378.05	396.24	(73)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
--------------	---------------------------	------------------------	------------------	----------------	----------------	--------------

## TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	2.38	x	10.63	x	0.63	x	0.7	=	7.73	(74)
North	0.9x	0.77	x	2.16	x	10.63	x	0.63	x	0.7	=	7.02	(74)
North	0.9x	0.77	x	2.16	x	10.63	x	0.63	x	0.7	=	7.02	(74)
North	0.9x	0.77	x	6.49	x	10.63	x	0.63	x	0.7	=	21.09	(74)
North	0.9x	0.77	x	2.16	x	10.63	x	0.63	x	0.7	=	7.02	(74)
North	0.9x	0.77	x	2.38	x	20.32	x	0.63	x	0.7	=	14.78	(74)
North	0.9x	0.77	x	2.16	x	20.32	x	0.63	x	0.7	=	13.41	(74)
North	0.9x	0.77	x	2.16	x	20.32	x	0.63	x	0.7	=	13.41	(74)
North	0.9x	0.77	x	6.49	x	20.32	x	0.63	x	0.7	=	40.31	(74)
North	0.9x	0.77	x	2.16	x	20.32	x	0.63	x	0.7	=	13.41	(74)
North	0.9x	0.77	x	2.38	x	34.53	x	0.63	x	0.7	=	25.12	(74)
North	0.9x	0.77	x	2.16	x	34.53	x	0.63	x	0.7	=	22.79	(74)
North	0.9x	0.77	x	2.16	x	34.53	x	0.63	x	0.7	=	22.79	(74)
North	0.9x	0.77	x	6.49	x	34.53	x	0.63	x	0.7	=	68.49	(74)
North	0.9x	0.77	x	2.16	x	34.53	x	0.63	x	0.7	=	22.79	(74)
North	0.9x	0.77	x	2.38	x	55.46	x	0.63	x	0.7	=	40.34	(74)
North	0.9x	0.77	x	2.16	x	55.46	x	0.63	x	0.7	=	36.61	(74)
North	0.9x	0.77	x	2.16	x	55.46	x	0.63	x	0.7	=	36.61	(74)
North	0.9x	0.77	x	6.49	x	55.46	x	0.63	x	0.7	=	110.01	(74)
North	0.9x	0.77	x	2.16	x	55.46	x	0.63	x	0.7	=	36.61	(74)
North	0.9x	0.77	x	2.38	x	74.72	x	0.63	x	0.7	=	54.35	(74)
North	0.9x	0.77	x	2.16	x	74.72	x	0.63	x	0.7	=	49.32	(74)
North	0.9x	0.77	x	2.16	x	74.72	x	0.63	x	0.7	=	49.32	(74)
North	0.9x	0.77	x	6.49	x	74.72	x	0.63	x	0.7	=	148.19	(74)
North	0.9x	0.77	x	2.16	x	74.72	x	0.63	x	0.7	=	49.32	(74)
North	0.9x	0.77	x	2.38	x	79.99	x	0.63	x	0.7	=	58.18	(74)
North	0.9x	0.77	x	2.16	x	79.99	x	0.63	x	0.7	=	52.8	(74)
North	0.9x	0.77	x	2.16	x	79.99	x	0.63	x	0.7	=	52.8	(74)
North	0.9x	0.77	x	6.49	x	79.99	x	0.63	x	0.7	=	158.65	(74)
North	0.9x	0.77	x	2.16	x	79.99	x	0.63	x	0.7	=	52.8	(74)
North	0.9x	0.77	x	2.38	x	74.68	x	0.63	x	0.7	=	54.32	(74)
North	0.9x	0.77	x	2.16	x	74.68	x	0.63	x	0.7	=	49.3	(74)
North	0.9x	0.77	x	2.16	x	74.68	x	0.63	x	0.7	=	49.3	(74)
North	0.9x	0.77	x	6.49	x	74.68	x	0.63	x	0.7	=	148.12	(74)
North	0.9x	0.77	x	2.16	x	74.68	x	0.63	x	0.7	=	49.3	(74)
North	0.9x	0.77	x	2.38	x	59.25	x	0.63	x	0.7	=	43.09	(74)
North	0.9x	0.77	x	2.16	x	59.25	x	0.63	x	0.7	=	39.11	(74)
North	0.9x	0.77	x	2.16	x	59.25	x	0.63	x	0.7	=	39.11	(74)
North	0.9x	0.77	x	6.49	x	59.25	x	0.63	x	0.7	=	117.51	(74)
North	0.9x	0.77	x	2.16	x	59.25	x	0.63	x	0.7	=	39.11	(74)
North	0.9x	0.77	x	2.38	x	41.52	x	0.63	x	0.7	=	30.2	(74)



## TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	2.16	x	41.52	x	0.63	x	0.7	=	27.41	(74)
North	0.9x	0.77	x	2.16	x	41.52	x	0.63	x	0.7	=	27.41	(74)
North	0.9x	0.77	x	6.49	x	41.52	x	0.63	x	0.7	=	82.35	(74)
North	0.9x	0.77	x	2.16	x	41.52	x	0.63	x	0.7	=	27.41	(74)
North	0.9x	0.77	x	2.38	x	24.19	x	0.63	x	0.7	=	17.59	(74)
North	0.9x	0.77	x	2.16	x	24.19	x	0.63	x	0.7	=	15.97	(74)
North	0.9x	0.77	x	2.16	x	24.19	x	0.63	x	0.7	=	15.97	(74)
North	0.9x	0.77	x	6.49	x	24.19	x	0.63	x	0.7	=	47.98	(74)
North	0.9x	0.77	x	2.16	x	24.19	x	0.63	x	0.7	=	15.97	(74)
North	0.9x	0.77	x	2.38	x	13.12	x	0.63	x	0.7	=	9.54	(74)
North	0.9x	0.77	x	2.16	x	13.12	x	0.63	x	0.7	=	8.66	(74)
North	0.9x	0.77	x	2.16	x	13.12	x	0.63	x	0.7	=	8.66	(74)
North	0.9x	0.77	x	6.49	x	13.12	x	0.63	x	0.7	=	26.02	(74)
North	0.9x	0.77	x	2.16	x	13.12	x	0.63	x	0.7	=	8.66	(74)
North	0.9x	0.77	x	2.38	x	8.86	x	0.63	x	0.7	=	6.45	(74)
North	0.9x	0.77	x	2.16	x	8.86	x	0.63	x	0.7	=	5.85	(74)
North	0.9x	0.77	x	2.16	x	8.86	x	0.63	x	0.7	=	5.85	(74)
North	0.9x	0.77	x	6.49	x	8.86	x	0.63	x	0.7	=	17.58	(74)
North	0.9x	0.77	x	2.16	x	8.86	x	0.63	x	0.7	=	5.85	(74)
East	0.9x	0.77	x	2.16	x	19.64	x	0.63	x	0.7	=	12.97	(76)
East	0.9x	0.77	x	2.16	x	38.42	x	0.63	x	0.7	=	25.36	(76)
East	0.9x	0.77	x	2.16	x	63.27	x	0.63	x	0.7	=	41.77	(76)
East	0.9x	0.77	x	2.16	x	92.28	x	0.63	x	0.7	=	60.92	(76)
East	0.9x	0.77	x	2.16	x	113.09	x	0.63	x	0.7	=	74.66	(76)
East	0.9x	0.77	x	2.16	x	115.77	x	0.63	x	0.7	=	76.42	(76)
East	0.9x	0.77	x	2.16	x	110.22	x	0.63	x	0.7	=	72.76	(76)
East	0.9x	0.77	x	2.16	x	94.68	x	0.63	x	0.7	=	62.5	(76)
East	0.9x	0.77	x	2.16	x	73.59	x	0.63	x	0.7	=	48.58	(76)
East	0.9x	0.77	x	2.16	x	45.59	x	0.63	x	0.7	=	30.09	(76)
East	0.9x	0.77	x	2.16	x	24.49	x	0.63	x	0.7	=	16.17	(76)
East	0.9x	0.77	x	2.16	x	16.15	x	0.63	x	0.7	=	10.66	(76)
South	0.9x	0.77	x	1.45	x	46.75	x	0.63	x	0.7	=	20.72	(78)
South	0.9x	0.77	x	1.45	x	76.57	x	0.63	x	0.7	=	33.93	(78)
South	0.9x	0.77	x	1.45	x	97.53	x	0.63	x	0.7	=	43.22	(78)
South	0.9x	0.77	x	1.45	x	110.23	x	0.63	x	0.7	=	48.85	(78)
South	0.9x	0.77	x	1.45	x	114.87	x	0.63	x	0.7	=	50.9	(78)
South	0.9x	0.77	x	1.45	x	110.55	x	0.63	x	0.7	=	48.99	(78)
South	0.9x	0.77	x	1.45	x	108.01	x	0.63	x	0.7	=	47.86	(78)
South	0.9x	0.77	x	1.45	x	104.89	x	0.63	x	0.7	=	46.48	(78)
South	0.9x	0.77	x	1.45	x	101.89	x	0.63	x	0.7	=	45.15	(78)
South	0.9x	0.77	x	1.45	x	82.59	x	0.63	x	0.7	=	36.6	(78)

## TER WorkSheet: New dwelling design stage

South  $0.9 \times \boxed{0.77} \times \boxed{1.45} \times \boxed{55.42} \times \boxed{0.63} \times \boxed{0.7} = \boxed{24.56}$  (78)

South  $0.9 \times \boxed{0.77} \times \boxed{1.45} \times \boxed{40.4} \times \boxed{0.63} \times \boxed{0.7} = \boxed{17.9}$  (78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	83.57	154.62	246.98	369.96	476.06	500.64	470.94	386.91	288.49	180.17	102.26	70.15	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	490.66	559.7	639.09	741.15	826.04	830.11	787.06	708.84	621.12	533.92	480.31	466.39	(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
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 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.95	0.84	0.66	0.5	0.57	0.84	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.67	19.83	20.11	20.49	20.8	20.96	20.99	20.98	20.86	20.46	20.01	19.65	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.88	19.89	19.89	19.9	19.91	19.92	19.92	19.92	19.91	19.91	19.9	19.89	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.79	0.57	0.38	0.45	0.76	0.96	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.13	18.36	18.76	19.31	19.72	19.89	19.91	19.91	19.8	19.28	18.63	18.11	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

fLA = Living area ÷ (4) = 

0.39
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 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.73	18.93	19.29	19.77	20.14	20.3	20.33	20.33	20.21	19.74	19.16	18.71	(92)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.73	18.93	19.29	19.77	20.14	20.3	20.33	20.33	20.21	19.74	19.16	18.71	(93)
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### 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.98	0.93	0.8	0.6	0.43	0.5	0.78	0.96	0.99	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	488.11	554.1	623.6	686.81	663.03	498.74	337.15	351.07	486.5	510.51	475.47	464.47	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(93)m – (96)m ]

(97)m=	1363.28	1321.54	1200.64	1006.55	779.37	520.32	340.51	357.58	560.44	844.19	1120.03	1354.58	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	651.13	515.72	429.32	230.22	86.55	0	0	0	0	248.26	464.08	662.24	
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Total per year (kWh/year) = Sum(98)1...5,9...12 = 

3287.53
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 (98)

Space heating requirement in kWh/m<sup>2</sup>/year 

43.37
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 (99)

### 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

Fraction of space heat from secondary/supplementary system 

0
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 (201)

## TER WorkSheet: New dwelling design stage

Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)																								
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)																								
Efficiency of main space heating system 1		93.5	(206)																								
Efficiency of secondary/supplementary heating system, %		0	(208)																								
	<table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <th style="width: 8.33%;">Jan</th> <th style="width: 8.33%;">Feb</th> <th style="width: 8.33%;">Mar</th> <th style="width: 8.33%;">Apr</th> <th style="width: 8.33%;">May</th> <th style="width: 8.33%;">Jun</th> <th style="width: 8.33%;">Jul</th> <th style="width: 8.33%;">Aug</th> <th style="width: 8.33%;">Sep</th> <th style="width: 8.33%;">Oct</th> <th style="width: 8.33%;">Nov</th> <th style="width: 8.33%;">Dec</th> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec													kWh/year	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec																
Space heating requirement (calculated above)		<table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <td>651.13</td><td>515.72</td><td>429.32</td><td>230.22</td><td>86.55</td><td>0</td><td>0</td><td>0</td><td>0</td><td>248.26</td><td>464.08</td><td>662.24</td> </tr> </table>	651.13	515.72	429.32	230.22	86.55	0	0	0	0	248.26	464.08	662.24													
651.13	515.72	429.32	230.22	86.55	0	0	0	0	248.26	464.08	662.24																
(211)m = {[ (98)m × (204)] } × 100 ÷ (206)		<table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <td>696.39</td><td>551.58</td><td>459.17</td><td>246.22</td><td>92.57</td><td>0</td><td>0</td><td>0</td><td>0</td><td>265.52</td><td>496.34</td><td>708.28</td> </tr> </table>	696.39	551.58	459.17	246.22	92.57	0	0	0	0	265.52	496.34	708.28		(211)											
696.39	551.58	459.17	246.22	92.57	0	0	0	0	265.52	496.34	708.28																
	Total (kWh/year) = Sum(211) <sub>1..5,10...12</sub> =	3516.07	(211)																								
Space heating fuel (secondary), kWh/month																											
= {[ (98)m × (201)] } × 100 ÷ (208)																											
(215)m =		<table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>	0	0	0	0	0	0	0	0	0	0	0	0													
0	0	0	0	0	0	0	0	0	0	0	0																
	Total (kWh/year) = Sum(215) <sub>1..5,10...12</sub> =	0	(215)																								

### Water heating

Output from water heater (calculated above)																
	<table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <td>194.53</td><td>171.47</td><td>180.11</td><td>161.49</td><td>158.28</td><td>141.47</td><td>135.9</td><td>149.08</td><td>148.8</td><td>167.45</td><td>177.02</td><td>189.86</td> </tr> </table>	194.53	171.47	180.11	161.49	158.28	141.47	135.9	149.08	148.8	167.45	177.02	189.86			
194.53	171.47	180.11	161.49	158.28	141.47	135.9	149.08	148.8	167.45	177.02	189.86					
Efficiency of water heater		79.8	(216)													
(217)m =		<table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <td>87.79</td><td>87.57</td><td>87.05</td><td>85.76</td><td>83.28</td><td>79.8</td><td>79.8</td><td>79.8</td><td>79.8</td><td>85.86</td><td>87.27</td><td>87.87</td> </tr> </table>	87.79	87.57	87.05	85.76	83.28	79.8	79.8	79.8	79.8	85.86	87.27	87.87	(217)	
87.79	87.57	87.05	85.76	83.28	79.8	79.8	79.8	79.8	85.86	87.27	87.87					
Fuel for water heating, kWh/month																
(219)m = (64)m × 100 ÷ (217)m																
(219)m =		<table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 5px;"> <tr> <td>221.58</td><td>195.81</td><td>206.9</td><td>188.31</td><td>190.06</td><td>177.28</td><td>170.3</td><td>186.81</td><td>186.46</td><td>195.03</td><td>202.84</td><td>216.06</td> </tr> </table>	221.58	195.81	206.9	188.31	190.06	177.28	170.3	186.81	186.46	195.03	202.84	216.06		
221.58	195.81	206.9	188.31	190.06	177.28	170.3	186.81	186.46	195.03	202.84	216.06					
	Total = Sum(219a) <sub>1..12</sub> =	2337.44	(219)													

### Annual totals

	<b>kWh/year</b>	<b>kWh/year</b>
Space heating fuel used, main system 1		3516.07
Water heating fuel used		2337.44
Electricity for pumps, fans and electric keep-hot		
central heating pump:		30
boiler with a fan-assisted flue		45
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75
Electricity for lighting		331.32

### 12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) ×	=	0.216	=	759.47
Space heating (secondary)	(215) ×	=	0.519	=	0
Water heating	(219) ×	=	0.216	=	504.89
Space and water heating	(261) + (262) + (263) + (264) =				1264.36
Electricity for pumps, fans and electric keep-hot	(231) ×	=	0.519	=	38.93
Electricity for lighting	(232) ×	=	0.519	=	171.96

# TER WorkSheet: New dwelling design stage

Total CO2, kg/year

sum of (265)...(271) =

1475.24 (272)

**TER =**

19.46 (273)



# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.09	0.1	0.1
------	------	-----	------	------	------	------	------	------	------	------	-----	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (25)

**3. Heat losses and heat loss parameter:**

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			1.5	x1/[1/(1.4)+0.04] =	1.99		(27)
Windows Type 2			9.95	x1/[1/(1.4)+0.04] =	13.19		(27)
Windows Type 3			1.5	x1/[1/(1.4)+0.04] =	1.99		(27)
Windows Type 4			1.5	x1/[1/(1.4)+0.04] =	1.99		(27)
Windows Type 5			5.34	x1/[1/(1.4)+0.04] =	7.08		(27)
Windows Type 6			2.24	x1/[1/(1.4)+0.04] =	2.97		(27)
Walls	48.18	22.03	26.15	x 0.12 =	3.14		(29)
Roof	76	0	76	x 0.1 =	7.6		(30)
Total area of elements, m <sup>2</sup>			124.18				(31)
Party wall			48.28	x 0 =	0		(32)

\* for windows and roof windows, use effective window U-value calculated using formula 1/[1/U-value+0.04] as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 39.94 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 9.61 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.55 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

## DER WorkSheet: New dwelling design stage

(38)m= 

14.73	14.59	14.45	13.76	13.62	12.93	12.93	12.79	13.2	13.62	13.9	14.17
-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------	-------

 (38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m= 

64.28	64.14	64	63.31	63.17	62.48	62.48	62.34	62.76	63.17	63.45	63.73
-------	-------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------

 Average = Sum(39)<sub>1...12</sub> / 12 = 

63.28
-------

 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m= 

0.85	0.84	0.84	0.83	0.83	0.82	0.82	0.82	0.83	0.83	0.83	0.84
------	------	------	------	------	------	------	------	------	------	------	------

 Average = Sum(40)<sub>1...12</sub> / 12 = 

0.83
------

 (40)

Number of days in month (Table 1a)

(41)m= 

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

 (41)

### 4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N 

2.38
------

 (42)  
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)  
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 

90.79
-------

 (43)  
 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.87	96.23	92.6	88.97	85.34	81.71	81.71	85.34	88.97	92.6	96.23	99.87

 Total = Sum(44)<sub>1...12</sub> = 

1089.44
---------

 (44)  
 Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)  
 (45)m= 

148.1	129.53	133.66	116.53	111.81	96.48	89.41	102.6	103.82	120.99	132.07	143.42
-------	--------	--------	--------	--------	-------	-------	-------	--------	--------	--------	--------

 Total = Sum(45)<sub>1...12</sub> = 

1428.42
---------

 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m= 

22.21	19.43	20.05	17.48	16.77	14.47	13.41	15.39	15.57	18.15	19.81	21.51
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 

0
---

 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 

0
---

 (48)

Temperature factor from Table 2b 

0
---

 (49)

Energy lost from water storage, kWh/year (48) x (49) = 

110
-----

 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 

0.02
------

 (51)

If community heating see section 4.3

Volume factor from Table 2a 

1.03
------

 (52)

Temperature factor from Table 2b 

0.6
-----

 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 

1.03
------

 (54)

Enter (50) or (54) in (55) 

1.03
------

 (55)

Water storage loss calculated for each month ((56)m = (55) x (41)m

(56)m= 

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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= 

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (57)

# DER WorkSheet: New dwelling design stage

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m= 

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m= 

203.37	179.45	188.94	170.02	167.09	149.98	144.68	157.87	157.32	176.27	185.57	198.7
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m= 

203.37	179.45	188.94	170.02	167.09	149.98	144.68	157.87	157.32	176.27	185.57	198.7
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

Output from water heater (annual)<sub>1...12</sub> 2079.26 (64)

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m= 

93.46	83.01	88.66	81.54	81.4	74.88	73.95	78.33	77.32	84.45	86.71	91.91
-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

**5. Internal gains (see Table 5 and 5a):**

Metabolic gains (Table 5), Watts

(66)m= 

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m= 

18.8	16.7	13.58	10.28	7.68	6.49	7.01	9.11	12.23	15.53	18.13	19.32
------	------	-------	-------	------	------	------	------	-------	-------	-------	-------

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m= 

210.88	213.07	207.55	195.81	180.99	167.07	157.76	155.57	161.09	172.83	187.65	201.57
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m= 

34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m= 

-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (71)

Water heating gains (Table 5)

(72)m= 

125.62	123.53	119.17	113.25	109.41	103.99	99.39	105.29	107.38	113.51	120.43	123.53
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

 (72)

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m= 

414.04	412.03	399.04	378.08	356.82	336.29	322.91	328.71	339.44	360.61	384.94	403.17
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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 m <sup>2</sup>	Flux Table 6a	g <sub>-</sub> Table 6b	FF Table 6c	Gains (W)						
East	0.9x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.77</td></tr></table>	0.77	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>1.5</td></tr></table>	1.5	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>19.64</td></tr></table>	19.64	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.4</td></tr></table>	0.4	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.8</td></tr></table>	0.8	= <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>6.53</td></tr></table> (76)	6.53
0.77												
1.5												
19.64												
0.4												
0.8												
6.53												
East	0.9x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.77</td></tr></table>	0.77	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>9.95</td></tr></table>	9.95	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>19.64</td></tr></table>	19.64	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.4</td></tr></table>	0.4	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.8</td></tr></table>	0.8	= <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>43.34</td></tr></table> (76)	43.34
0.77												
9.95												
19.64												
0.4												
0.8												
43.34												



## DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	1.5	x	19.64	x	0.4	x	0.8	=	6.53	(76)
East	0.9x	0.77	x	1.5	x	38.42	x	0.4	x	0.8	=	12.78	(76)
East	0.9x	0.77	x	9.95	x	38.42	x	0.4	x	0.8	=	84.78	(76)
East	0.9x	0.77	x	1.5	x	38.42	x	0.4	x	0.8	=	12.78	(76)
East	0.9x	0.77	x	1.5	x	63.27	x	0.4	x	0.8	=	21.05	(76)
East	0.9x	0.77	x	9.95	x	63.27	x	0.4	x	0.8	=	139.61	(76)
East	0.9x	0.77	x	1.5	x	63.27	x	0.4	x	0.8	=	21.05	(76)
East	0.9x	0.77	x	1.5	x	92.28	x	0.4	x	0.8	=	30.7	(76)
East	0.9x	0.77	x	9.95	x	92.28	x	0.4	x	0.8	=	203.62	(76)
East	0.9x	0.77	x	1.5	x	92.28	x	0.4	x	0.8	=	30.7	(76)
East	0.9x	0.77	x	1.5	x	113.09	x	0.4	x	0.8	=	37.62	(76)
East	0.9x	0.77	x	9.95	x	113.09	x	0.4	x	0.8	=	249.54	(76)
East	0.9x	0.77	x	1.5	x	113.09	x	0.4	x	0.8	=	37.62	(76)
East	0.9x	0.77	x	1.5	x	115.77	x	0.4	x	0.8	=	38.51	(76)
East	0.9x	0.77	x	9.95	x	115.77	x	0.4	x	0.8	=	255.45	(76)
East	0.9x	0.77	x	1.5	x	115.77	x	0.4	x	0.8	=	38.51	(76)
East	0.9x	0.77	x	1.5	x	110.22	x	0.4	x	0.8	=	36.66	(76)
East	0.9x	0.77	x	9.95	x	110.22	x	0.4	x	0.8	=	243.2	(76)
East	0.9x	0.77	x	1.5	x	110.22	x	0.4	x	0.8	=	36.66	(76)
East	0.9x	0.77	x	1.5	x	94.68	x	0.4	x	0.8	=	31.49	(76)
East	0.9x	0.77	x	9.95	x	94.68	x	0.4	x	0.8	=	208.9	(76)
East	0.9x	0.77	x	1.5	x	94.68	x	0.4	x	0.8	=	31.49	(76)
East	0.9x	0.77	x	1.5	x	73.59	x	0.4	x	0.8	=	24.48	(76)
East	0.9x	0.77	x	9.95	x	73.59	x	0.4	x	0.8	=	162.38	(76)
East	0.9x	0.77	x	1.5	x	73.59	x	0.4	x	0.8	=	24.48	(76)
East	0.9x	0.77	x	1.5	x	45.59	x	0.4	x	0.8	=	15.16	(76)
East	0.9x	0.77	x	9.95	x	45.59	x	0.4	x	0.8	=	100.59	(76)
East	0.9x	0.77	x	1.5	x	45.59	x	0.4	x	0.8	=	15.16	(76)
East	0.9x	0.77	x	1.5	x	24.49	x	0.4	x	0.8	=	8.15	(76)
East	0.9x	0.77	x	9.95	x	24.49	x	0.4	x	0.8	=	54.04	(76)
East	0.9x	0.77	x	1.5	x	24.49	x	0.4	x	0.8	=	8.15	(76)
East	0.9x	0.77	x	1.5	x	16.15	x	0.4	x	0.8	=	5.37	(76)
East	0.9x	0.77	x	9.95	x	16.15	x	0.4	x	0.8	=	35.64	(76)
East	0.9x	0.77	x	1.5	x	16.15	x	0.4	x	0.8	=	5.37	(76)
South	0.9x	0.77	x	1.5	x	46.75	x	0.4	x	0.8	=	15.55	(78)
South	0.9x	0.77	x	5.34	x	46.75	x	0.4	x	0.8	=	55.36	(78)
South	0.9x	0.77	x	2.24	x	46.75	x	0.4	x	0.8	=	23.22	(78)
South	0.9x	0.77	x	1.5	x	76.57	x	0.4	x	0.8	=	25.47	(78)
South	0.9x	0.77	x	5.34	x	76.57	x	0.4	x	0.8	=	90.67	(78)
South	0.9x	0.77	x	2.24	x	76.57	x	0.4	x	0.8	=	38.03	(78)
South	0.9x	0.77	x	1.5	x	97.53	x	0.4	x	0.8	=	32.44	(78)

## DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	5.34	x	97.53	x	0.4	x	0.8	=	115.5	(78)
South	0.9x	0.77	x	2.24	x	97.53	x	0.4	x	0.8	=	48.45	(78)
South	0.9x	0.77	x	1.5	x	110.23	x	0.4	x	0.8	=	36.67	(78)
South	0.9x	0.77	x	5.34	x	110.23	x	0.4	x	0.8	=	130.54	(78)
South	0.9x	0.77	x	2.24	x	110.23	x	0.4	x	0.8	=	54.76	(78)
South	0.9x	0.77	x	1.5	x	114.87	x	0.4	x	0.8	=	38.21	(78)
South	0.9x	0.77	x	5.34	x	114.87	x	0.4	x	0.8	=	136.03	(78)
South	0.9x	0.77	x	2.24	x	114.87	x	0.4	x	0.8	=	57.06	(78)
South	0.9x	0.77	x	1.5	x	110.55	x	0.4	x	0.8	=	36.77	(78)
South	0.9x	0.77	x	5.34	x	110.55	x	0.4	x	0.8	=	130.91	(78)
South	0.9x	0.77	x	2.24	x	110.55	x	0.4	x	0.8	=	54.91	(78)
South	0.9x	0.77	x	1.5	x	108.01	x	0.4	x	0.8	=	35.93	(78)
South	0.9x	0.77	x	5.34	x	108.01	x	0.4	x	0.8	=	127.91	(78)
South	0.9x	0.77	x	2.24	x	108.01	x	0.4	x	0.8	=	53.65	(78)
South	0.9x	0.77	x	1.5	x	104.89	x	0.4	x	0.8	=	34.89	(78)
South	0.9x	0.77	x	5.34	x	104.89	x	0.4	x	0.8	=	124.22	(78)
South	0.9x	0.77	x	2.24	x	104.89	x	0.4	x	0.8	=	52.11	(78)
South	0.9x	0.77	x	1.5	x	101.89	x	0.4	x	0.8	=	33.89	(78)
South	0.9x	0.77	x	5.34	x	101.89	x	0.4	x	0.8	=	120.65	(78)
South	0.9x	0.77	x	2.24	x	101.89	x	0.4	x	0.8	=	50.61	(78)
South	0.9x	0.77	x	1.5	x	82.59	x	0.4	x	0.8	=	27.47	(78)
South	0.9x	0.77	x	5.34	x	82.59	x	0.4	x	0.8	=	97.8	(78)
South	0.9x	0.77	x	2.24	x	82.59	x	0.4	x	0.8	=	41.02	(78)
South	0.9x	0.77	x	1.5	x	55.42	x	0.4	x	0.8	=	18.43	(78)
South	0.9x	0.77	x	5.34	x	55.42	x	0.4	x	0.8	=	65.62	(78)
South	0.9x	0.77	x	2.24	x	55.42	x	0.4	x	0.8	=	27.53	(78)
South	0.9x	0.77	x	1.5	x	40.4	x	0.4	x	0.8	=	13.44	(78)
South	0.9x	0.77	x	5.34	x	40.4	x	0.4	x	0.8	=	47.84	(78)
South	0.9x	0.77	x	2.24	x	40.4	x	0.4	x	0.8	=	20.07	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	150.54	264.51	378.1	486.98	556.08	555.07	534.01	483.1	416.49	297.22	181.91	127.73	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	564.58	676.54	777.14	865.06	912.91	891.35	856.92	811.82	755.93	657.82	566.85	530.9	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.93	0.81	0.63	0.45	0.32	0.35	0.57	0.87	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.33	20.51	20.73	20.91	20.98	21	21	21	20.99	20.89	20.57	20.29	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.21	20.22	20.22	20.22	20.23	20.23	20.23	20.24	20.23	20.23	20.22	20.22	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

## DER WorkSheet: New dwelling design stage

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.97	0.91	0.77	0.58	0.39	0.26	0.29	0.51	0.83	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.33	19.59	19.89	20.13	20.21	20.23	20.23	20.24	20.23	20.11	19.68	19.27	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$fLA = \text{Living area} \div (4) =$	0.36	(91)
---------------------------------------	------	------

Mean internal temperature (for the whole dwelling) =  $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.69	19.92	20.2	20.42	20.49	20.51	20.51	20.51	20.5	20.39	20	19.64	(92)
--------	-------	-------	------	-------	-------	-------	-------	-------	------	-------	----	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.69	19.92	20.2	20.42	20.49	20.51	20.51	20.51	20.5	20.39	20	19.64	(93)
--------	-------	-------	------	-------	-------	-------	-------	-------	------	-------	----	-------	------

### 8. Space heating requirement

Set  $T_i$  to the mean internal temperature obtained at step 11 of Table 9b, so that  $T_{i,m}=(76)m$  and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.91	0.78	0.6	0.41	0.29	0.32	0.53	0.84	0.97	0.99	(94)
--------	------	------	------	------	-----	------	------	------	------	------	------	------	------

Useful gains, hmGm ,  $W = (94)m \times (84)m$

(95)m=	558.06	654.66	709.33	677.57	546.84	368.58	244.26	256.21	398.93	552.31	550.09	526.48	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature,  $Lm , W = [(39)m \times [(93)m - (96)m ]$

(97)m=	989.07	963.63	876.6	729.02	555.34	369.2	244.31	256.29	401.85	618.4	818.71	983.89	(97)
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Space heating requirement for each month, kWh/month =  $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	320.68	207.63	124.45	37.05	6.33	0	0	0	0	49.17	193.41	340.31	
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$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1...5,9...12} =$	1279.01	(98)
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Space heating requirement in kWh/m<sup>2</sup>/year

	16.83	(99)
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### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

Fraction of heat from Community boilers 1 (303a)

Fraction of total space heat from Community boilers (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.1 (306)

#### Space heating

Annual space heating requirement 1279.01

Space heat from Community boilers (98) x (304a) x (305) x (306) = 1406.91 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0 (308)

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = 0 (309)

## DER WorkSheet: New dwelling design stage

### Water heating

Annual water heating requirement		2079.26	
If DHW from community scheme: Water heat from Community boilers	$(64) \times (303a) \times (305) \times (306) =$	2287.19	(310a)
Electricity used for heat distribution	$0.01 \times [(307a)...(307e) + (310a)...(310e)] =$	36.94	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	$= (107) \div (314) =$	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		159.71	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	$= (330a) + (330b) + (330g) =$	159.71	(331)
Energy for lighting (calculated in Appendix L)		332.01	(332)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)			95
	<i>If there is CHP using two fuels repeat (363) to (366) for the second fuel</i>		(367a)
CO2 associated with heat source 1	$[(307b)+(310b)] \times 100 \div (367b) \times$	0.22	839.92
			(367)
Electrical energy for heat distribution	$[(313) \times$	0.52	19.17
			(372)
Total CO2 associated with community systems	$(363)...(366) + (368)...(372)$		859.1
			(373)
CO2 associated with space heating (secondary)	$(309) \times$	0	0
			(374)
CO2 associated with water from immersion heater or instantaneous heater	$(312) \times$	0.22	0
			(375)
Total CO2 associated with space and water heating	$(373) + (374) + (375) =$		859.1
			(376)
CO2 associated with electricity for pumps and fans within dwelling	$(331) \times$	0.52	82.89
			(378)
CO2 associated with electricity for lighting	$(332)) \times$	0.52	172.31
			(379)
<b>Total CO2, kg/year</b>	<i>sum of (376)...(382) =</i>		1114.3
			(383)
<b>Dwelling CO2 Emission Rate</b>	$(383) \div (4) =$		14.66
			(384)
<b>EI rating (section 14)</b>			87.66
			(385)

## TER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

### Property Address: GT 403 - Be Lean

**Address :** GT 403, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	76	(1a) x	2.6	(2a) =	197.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76	(4)			
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =				197.6 (5)

### 2. Ventilation rate:

	main heating	secondary heating	other	total		m <sup>3</sup> 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					3	x 10 =	30	(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) =	30	÷ (5) =	0.15	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration			0	[(9)-1]x0.1 = (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.4	(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.34	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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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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# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4
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Calculate effective air change rate for the applicable case

If mechanical ventilation:  (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)  (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =  (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	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)m<sup>2</sup> x 0.5]

(24d)m= 

0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58
------	------	------	------	------	------	------	------	------	------	------	------

(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 

0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58
------	------	------	------	------	------	------	------	------	------	------	------

(25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			<input type="text" value="1.29"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.71"/>		(27)
Windows Type 2			<input type="text" value="8.58"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="11.37"/>		(27)
Windows Type 3			<input type="text" value="1.29"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.71"/>		(27)
Windows Type 4			<input type="text" value="1.29"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.71"/>		(27)
Windows Type 5			<input type="text" value="4.61"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="6.11"/>		(27)
Windows Type 6			<input type="text" value="1.93"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.56"/>		(27)
Walls	<input type="text" value="48.18"/>	<input type="text" value="18.99"/>	<input type="text" value="29.19"/>	$x$ <input type="text" value="0.18"/>	$=$ <input type="text" value="5.25"/>	<input type="text"/>	(29)
Roof	<input type="text" value="76"/>	<input type="text" value="0"/>	<input type="text" value="76"/>	$x$ <input type="text" value="0.13"/>	$=$ <input type="text" value="9.88"/>	<input type="text"/>	(30)
Total area of elements, m <sup>2</sup>			<input type="text" value="124.18"/>				(31)
Party wall			<input type="text" value="48.28"/>	$x$ <input type="text" value="0"/>	$=$ <input type="text" value="0"/>	<input type="text"/>	(32)

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[1/U\text{-value}+0.04]$  as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) =  (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) =  (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium  (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  (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) =  (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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(38)m=	38.79	38.55	38.31	37.21	37	36.04	36.04	35.86	36.41	37	37.42	37.86	(38)
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Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

(39)m=	86.09	85.85	85.61	84.51	84.3	83.34	83.34	83.16	83.71	84.3	84.72	85.16	
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$$\text{Average} = \text{Sum}(39)_{1...12} / 12 =$$

84.51	(39)
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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.13	1.13	1.13	1.11	1.11	1.1	1.1	1.09	1.1	1.11	1.11	1.12	
--------	------	------	------	------	------	-----	-----	------	-----	------	------	------	--

$$\text{Average} = \text{Sum}(40)_{1...12} / 12 =$$

1.11	(40)
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Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

### 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 

2.38	(42)
------	------

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 

90.79	(43)
-------	------

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)*

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	99.87	96.23	92.6	88.97	85.34	81.71	81.71	85.34	88.97	92.6	96.23	99.87	
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$$\text{Total} = \text{Sum}(44)_{1...12} =$$

1089.44	(44)
---------	------

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	148.1	129.53	133.66	116.53	111.81	96.48	89.41	102.6	103.82	120.99	132.07	143.42	
--------	-------	--------	--------	--------	--------	-------	-------	-------	--------	--------	--------	--------	--

$$\text{Total} = \text{Sum}(45)_{1...12} =$$

1428.42	(45)
---------	------

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.21	19.43	20.05	17.48	16.77	14.47	13.41	15.39	15.57	18.15	19.81	21.51	(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 

150	(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): 

1.39	(48)
------	------

Temperature factor from Table 2b 

0.54	(49)
------	------

Energy lost from water storage, kWh/year (48) x (49) = 

0.75	(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) 

0.75	(55)
------	------

Water storage loss calculated for each month (56)m = (55) x (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

# TER WorkSheet: New dwelling design stage

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m= 

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m= 

194.69	171.61	180.25	161.62	158.41	141.58	136	149.19	148.91	167.59	177.17	190.02
--------	--------	--------	--------	--------	--------	-----	--------	--------	--------	--------	--------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m= 

194.69	171.61	180.25	161.62	158.41	141.58	136	149.19	148.91	167.59	177.17	190.02
--------	--------	--------	--------	--------	--------	-----	--------	--------	--------	--------	--------

Output from water heater (annual)<sub>1...12</sub> 1977.04 (64)

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m= 

86.52	76.74	81.72	74.82	74.45	68.15	67	71.39	70.59	77.51	79.99	84.96
-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

(66)m= 

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13	119.13

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m= 

18.8	16.7	13.58	10.28	7.68	6.49	7.01	9.11	12.23	15.53	18.13	19.32
------	------	-------	-------	------	------	------	------	-------	-------	-------	-------

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m= 

210.88	213.07	207.55	195.81	180.99	167.07	157.76	155.57	161.09	172.83	187.65	201.57
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m= 

34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91	34.91
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m= 

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m= 

-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3	-95.3
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (71)

Water heating gains (Table 5)

(72)m= 

116.29	114.19	109.84	103.92	100.07	94.66	90.06	95.95	98.05	104.18	111.09	114.2
--------	--------	--------	--------	--------	-------	-------	-------	-------	--------	--------	-------

 (72)

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m= 

407.7	405.69	392.71	371.75	350.49	329.95	316.57	322.38	333.1	354.27	378.61	396.83
-------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

 (73)

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub>-</sub> Table 6b	FF Table 6c	Gains (W)
East	0.9x <span style="border: 1px solid black; padding: 2px 10px;">0.77</span>	x <span style="border: 1px solid black; padding: 2px 10px;">1.29</span>	x <span style="border: 1px solid black; padding: 2px 10px;">19.64</span>	x <span style="border: 1px solid black; padding: 2px 10px;">0.63</span>	x <span style="border: 1px solid black; padding: 2px 10px;">0.7</span>	= <span style="border: 1px solid black; padding: 2px 10px;">7.74</span> (76)
East	0.9x <span style="border: 1px solid black; padding: 2px 10px;">0.77</span>	x <span style="border: 1px solid black; padding: 2px 10px;">8.58</span>	x <span style="border: 1px solid black; padding: 2px 10px;">19.64</span>	x <span style="border: 1px solid black; padding: 2px 10px;">0.63</span>	x <span style="border: 1px solid black; padding: 2px 10px;">0.7</span>	= <span style="border: 1px solid black; padding: 2px 10px;">51.5</span> (76)



## TER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	1.29	x	19.64	x	0.63	x	0.7	=	7.74	(76)
East	0.9x	0.77	x	1.29	x	38.42	x	0.63	x	0.7	=	15.15	(76)
East	0.9x	0.77	x	8.58	x	38.42	x	0.63	x	0.7	=	100.74	(76)
East	0.9x	0.77	x	1.29	x	38.42	x	0.63	x	0.7	=	15.15	(76)
East	0.9x	0.77	x	1.29	x	63.27	x	0.63	x	0.7	=	24.94	(76)
East	0.9x	0.77	x	8.58	x	63.27	x	0.63	x	0.7	=	165.91	(76)
East	0.9x	0.77	x	1.29	x	63.27	x	0.63	x	0.7	=	24.94	(76)
East	0.9x	0.77	x	1.29	x	92.28	x	0.63	x	0.7	=	36.38	(76)
East	0.9x	0.77	x	8.58	x	92.28	x	0.63	x	0.7	=	241.97	(76)
East	0.9x	0.77	x	1.29	x	92.28	x	0.63	x	0.7	=	36.38	(76)
East	0.9x	0.77	x	1.29	x	113.09	x	0.63	x	0.7	=	44.59	(76)
East	0.9x	0.77	x	8.58	x	113.09	x	0.63	x	0.7	=	296.55	(76)
East	0.9x	0.77	x	1.29	x	113.09	x	0.63	x	0.7	=	44.59	(76)
East	0.9x	0.77	x	1.29	x	115.77	x	0.63	x	0.7	=	45.64	(76)
East	0.9x	0.77	x	8.58	x	115.77	x	0.63	x	0.7	=	303.57	(76)
East	0.9x	0.77	x	1.29	x	115.77	x	0.63	x	0.7	=	45.64	(76)
East	0.9x	0.77	x	1.29	x	110.22	x	0.63	x	0.7	=	43.45	(76)
East	0.9x	0.77	x	8.58	x	110.22	x	0.63	x	0.7	=	289.01	(76)
East	0.9x	0.77	x	1.29	x	110.22	x	0.63	x	0.7	=	43.45	(76)
East	0.9x	0.77	x	1.29	x	94.68	x	0.63	x	0.7	=	37.33	(76)
East	0.9x	0.77	x	8.58	x	94.68	x	0.63	x	0.7	=	248.26	(76)
East	0.9x	0.77	x	1.29	x	94.68	x	0.63	x	0.7	=	37.33	(76)
East	0.9x	0.77	x	1.29	x	73.59	x	0.63	x	0.7	=	29.01	(76)
East	0.9x	0.77	x	8.58	x	73.59	x	0.63	x	0.7	=	192.96	(76)
East	0.9x	0.77	x	1.29	x	73.59	x	0.63	x	0.7	=	29.01	(76)
East	0.9x	0.77	x	1.29	x	45.59	x	0.63	x	0.7	=	17.97	(76)
East	0.9x	0.77	x	8.58	x	45.59	x	0.63	x	0.7	=	119.54	(76)
East	0.9x	0.77	x	1.29	x	45.59	x	0.63	x	0.7	=	17.97	(76)
East	0.9x	0.77	x	1.29	x	24.49	x	0.63	x	0.7	=	9.65	(76)
East	0.9x	0.77	x	8.58	x	24.49	x	0.63	x	0.7	=	64.21	(76)
East	0.9x	0.77	x	1.29	x	24.49	x	0.63	x	0.7	=	9.65	(76)
East	0.9x	0.77	x	1.29	x	16.15	x	0.63	x	0.7	=	6.37	(76)
East	0.9x	0.77	x	8.58	x	16.15	x	0.63	x	0.7	=	42.35	(76)
East	0.9x	0.77	x	1.29	x	16.15	x	0.63	x	0.7	=	6.37	(76)
South	0.9x	0.77	x	1.29	x	46.75	x	0.63	x	0.7	=	18.43	(78)
South	0.9x	0.77	x	4.61	x	46.75	x	0.63	x	0.7	=	65.87	(78)
South	0.9x	0.77	x	1.93	x	46.75	x	0.63	x	0.7	=	27.58	(78)
South	0.9x	0.77	x	1.29	x	76.57	x	0.63	x	0.7	=	30.19	(78)
South	0.9x	0.77	x	4.61	x	76.57	x	0.63	x	0.7	=	107.87	(78)
South	0.9x	0.77	x	1.93	x	76.57	x	0.63	x	0.7	=	45.16	(78)
South	0.9x	0.77	x	1.29	x	97.53	x	0.63	x	0.7	=	38.45	(78)

## TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	4.61	x	97.53	x	0.63	x	0.7	=	137.41	(78)
South	0.9x	0.77	x	1.93	x	97.53	x	0.63	x	0.7	=	57.53	(78)
South	0.9x	0.77	x	1.29	x	110.23	x	0.63	x	0.7	=	43.46	(78)
South	0.9x	0.77	x	4.61	x	110.23	x	0.63	x	0.7	=	155.31	(78)
South	0.9x	0.77	x	1.93	x	110.23	x	0.63	x	0.7	=	65.02	(78)
South	0.9x	0.77	x	1.29	x	114.87	x	0.63	x	0.7	=	45.29	(78)
South	0.9x	0.77	x	4.61	x	114.87	x	0.63	x	0.7	=	161.84	(78)
South	0.9x	0.77	x	1.93	x	114.87	x	0.63	x	0.7	=	67.75	(78)
South	0.9x	0.77	x	1.29	x	110.55	x	0.63	x	0.7	=	43.58	(78)
South	0.9x	0.77	x	4.61	x	110.55	x	0.63	x	0.7	=	155.75	(78)
South	0.9x	0.77	x	1.93	x	110.55	x	0.63	x	0.7	=	65.2	(78)
South	0.9x	0.77	x	1.29	x	108.01	x	0.63	x	0.7	=	42.58	(78)
South	0.9x	0.77	x	4.61	x	108.01	x	0.63	x	0.7	=	152.18	(78)
South	0.9x	0.77	x	1.93	x	108.01	x	0.63	x	0.7	=	63.71	(78)
South	0.9x	0.77	x	1.29	x	104.89	x	0.63	x	0.7	=	41.35	(78)
South	0.9x	0.77	x	4.61	x	104.89	x	0.63	x	0.7	=	147.78	(78)
South	0.9x	0.77	x	1.93	x	104.89	x	0.63	x	0.7	=	61.87	(78)
South	0.9x	0.77	x	1.29	x	101.89	x	0.63	x	0.7	=	40.17	(78)
South	0.9x	0.77	x	4.61	x	101.89	x	0.63	x	0.7	=	143.54	(78)
South	0.9x	0.77	x	1.93	x	101.89	x	0.63	x	0.7	=	60.1	(78)
South	0.9x	0.77	x	1.29	x	82.59	x	0.63	x	0.7	=	32.56	(78)
South	0.9x	0.77	x	4.61	x	82.59	x	0.63	x	0.7	=	116.35	(78)
South	0.9x	0.77	x	1.93	x	82.59	x	0.63	x	0.7	=	48.71	(78)
South	0.9x	0.77	x	1.29	x	55.42	x	0.63	x	0.7	=	21.85	(78)
South	0.9x	0.77	x	4.61	x	55.42	x	0.63	x	0.7	=	78.08	(78)
South	0.9x	0.77	x	1.93	x	55.42	x	0.63	x	0.7	=	32.69	(78)
South	0.9x	0.77	x	1.29	x	40.4	x	0.63	x	0.7	=	15.93	(78)
South	0.9x	0.77	x	4.61	x	40.4	x	0.63	x	0.7	=	56.92	(78)
South	0.9x	0.77	x	1.93	x	40.4	x	0.63	x	0.7	=	23.83	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	178.86	314.26	449.2	578.52	660.6	659.39	634.38	573.91	494.79	353.11	216.13	151.76	(83)
--------	--------	--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	586.57	719.96	841.9	950.27	1011.09	989.34	950.95	896.29	827.9	707.38	594.74	548.59	(84)
--------	--------	--------	-------	--------	---------	--------	--------	--------	-------	--------	--------	--------	------

### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.87	0.72	0.53	0.38	0.42	0.66	0.91	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.94	20.16	20.45	20.75	20.93	20.99	21	21	20.96	20.71	20.26	19.9	(87)
--------	-------	-------	-------	-------	-------	-------	----	----	-------	-------	-------	------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.97	19.98	19.98	19.99	19.99	20	20	20.01	20	19.99	19.99	19.98	(88)
--------	-------	-------	-------	-------	-------	----	----	-------	----	-------	-------	-------	------

## TER WorkSheet: New dwelling design stage

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.94	0.83	0.66	0.45	0.3	0.33	0.58	0.88	0.98	0.99	(89)
--------	------	------	------	------	------	------	-----	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.58	18.9	19.32	19.72	19.93	20	20	20	19.97	19.69	19.06	18.53	(90)
--------	-------	------	-------	-------	-------	----	----	----	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = \boxed{0.36} \quad (91)$$

Mean internal temperature (for the whole dwelling) =  $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.07	19.36	19.73	20.09	20.29	20.35	20.36	20.36	20.33	20.06	19.49	19.02	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.07	19.36	19.73	20.09	20.29	20.35	20.36	20.36	20.33	20.06	19.49	19.02	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

### 8. Space heating requirement

Set  $T_i$  to the mean internal temperature obtained at step 11 of Table 9b, so that  $T_{i,m}=(76)m$  and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.93	0.84	0.67	0.48	0.33	0.37	0.61	0.88	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, hmGm ,  $W = (94)m \times (84)m$

(95)m=	580.34	700.43	785.11	794.31	682.14	473.81	312.86	328.38	503.06	625.1	580.53	544.26	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature,  $Lm , W = [(93)m - (96)m]$

(97)m=	1271.6	1241.16	1132.29	946.04	723.98	479.5	313.5	329.5	521.54	797.19	1050.09	1262.43	(97)
--------	--------	---------	---------	--------	--------	-------	-------	-------	--------	--------	---------	---------	------

Space heating requirement for each month, kWh/month =  $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	514.3	363.37	258.3	109.25	31.13	0	0	0	0	128.03	338.08	534.32	
--------	-------	--------	-------	--------	-------	---	---	---	---	--------	--------	--------	--

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1...5,9...12} = \boxed{2276.77} \quad (98)$$

Space heating requirement in kWh/m<sup>2</sup>/year

$$\boxed{29.96} \quad (99)$$

### 9a. Energy requirements – Individual heating systems including micro-CHP)

#### Space heating:

Fraction of space heat from secondary/supplementary system  (201)

Fraction of space heat from main system(s) (202) = 1 - (201) =  (202)

Fraction of total heating from main system 1 (204) = (202) × [1 - (203)] =  (204)

Efficiency of main space heating system 1  (206)

Efficiency of secondary/supplementary heating system, %  (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

514.3	363.37	258.3	109.25	31.13	0	0	0	0	128.03	338.08	534.32
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(211)m =  $\{[(98)m \times (204)]\} \times 100 \div (206)$  (211)

550.05	388.63	276.25	116.84	33.29	0	0	0	0	136.93	361.58	571.46
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1...5,10...12} = \boxed{2435.04} \quad (211)$$

Space heating fuel (secondary), kWh/month

=  $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
---------	---	---	---	---	---	---	---	---	---	---	---	--

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1...5,10...12} = \boxed{0} \quad (215)$$

# TER WorkSheet: New dwelling design stage

## Water heating

Output from water heater (calculated above)

194.69	171.61	180.25	161.62	158.41	141.58	136	149.19	148.91	167.59	177.17	190.02
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Efficiency of water heater

79.8 (216)

(217)m= 87.29 86.77 85.77 83.8 81.38 79.8 79.8 79.8 79.8 84.11 86.51 87.42 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=

223.05	197.78	210.15	192.87	194.65	177.41	170.43	186.96	186.61	199.26	204.79	217.35
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Total = Sum(219a)<sub>1..12</sub> =

2361.31 (219)

## Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2435.04

Water heating fuel used

2361.31

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

332.01 (232)

## 12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	= 525.97 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 510.04 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1036.01 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 38.93 (267)
Electricity for lighting	(232) x	0.519	= 172.31 (268)
Total CO2, kg/year		sum of (265)...(271) =	1247.25 (272)

**TER =** 16.41 (273)



# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
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 (25)

**3. Heat losses and heat loss parameter:**

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			1.5	x1/[1/( 1.4 )+ 0.04] =	1.99		(27)
Windows Type 2			2.24	x1/[1/( 1.4 )+ 0.04] =	2.97		(27)
Windows Type 3			1.5	x1/[1/( 1.4 )+ 0.04] =	1.99		(27)
Windows Type 4			6.73	x1/[1/( 1.4 )+ 0.04] =	8.92		(27)
Walls	50.8	11.97	38.83	x 0.12 =	4.66		(29)
Roof	57	0	57	x 0.1 =	5.7		(30)
Total area of elements, m <sup>2</sup>			107.8				(31)
Party wall			28.34	x 0 =	0		(32)

\* for windows and roof windows, use effective window U-value calculated using formula 1/[1/U-value)+0.04] as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 26.23 (33)

Heat capacity Cm = S(A x k ) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 7.64 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 33.87 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	11.05	10.94	10.84	10.32	10.22	9.7	9.7	9.59	9.9	10.22	10.42	10.63

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	44.92	44.81	44.71	44.19	44.09	43.57	43.57	43.46	43.77	44.09	44.29	44.5
Average = Sum(39) <sub>1...12</sub> /12=												44.16 (39)

## DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m<sup>2</sup>K

(40)m = (39)m ÷ (4)

(40)m=	0.79	0.79	0.78	0.78	0.77	0.76	0.76	0.76	0.77	0.77	0.78	0.78	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.77	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

### 4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)<sup>2</sup>)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day V<sub>d,average</sub> = (25 x N) + 36 79.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month V <sub>d,m</sub> = factor from Table 1c x (43)													
(44)m=	87.14	83.98	80.81	77.64	74.47	71.3	71.3	74.47	77.64	80.81	83.98	87.14	
Total = Sum(44) <sub>1...12</sub> =												950.67	(44)

Energy content of hot water used - calculated monthly = 4.190 x V<sub>d,m</sub> x nm x DT<sub>m</sub> / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	129.23	113.03	116.63	101.68	97.57	84.19	78.02	89.53	90.6	105.58	115.25	125.15	
Total = Sum(45) <sub>1...12</sub> =												1246.47	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m= 19.38 16.95 17.5 15.25 14.64 12.63 11.7 13.43 13.59 15.84 17.29 18.77 (46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	184.51	162.96	171.91	155.18	152.85	137.69	133.3	144.8	144.09	160.86	168.74	180.43	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	184.51	162.96	171.91	155.18	152.85	137.69	133.3	144.8	144.09	160.86	168.74	180.43	
Output from water heater (annual) <sub>1...12</sub>												(64)	
												1897.31	

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	87.19	77.52	83	76.61	76.66	70.79	70.16	73.99	72.92	79.33	81.12	85.84	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.74	13.09	10.65	8.06	6.02	5.09	5.5	7.14	9.59	12.17	14.21	15.15	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	165.32	167.04	162.72	153.51	141.89	130.98	123.68	121.97	126.29	135.49	147.11	158.03	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48	(69)
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Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	(71)
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Water heating gains (Table 5)

(72)m=	117.19	115.36	111.56	106.4	103.04	98.32	94.3	99.45	101.28	106.62	112.66	115.37	(72)
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**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	348.69	346.93	336.36	319.4	302.4	285.82	274.92	279.99	288.59	305.72	325.42	339.98	(73)
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## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	x	Area m <sup>2</sup>	x	Flux Table 6a	x	g <sub>g</sub> Table 6b	x	FF Table 6c	=	Gains (W)			
North	0.9x		0.77	x	2.24	x	10.63	x	0.4	x	0.8	=	5.28	(74)
North	0.9x		0.77	x	1.5	x	10.63	x	0.4	x	0.8	=	3.54	(74)
North	0.9x		0.77	x	6.73	x	10.63	x	0.4	x	0.8	=	15.87	(74)
North	0.9x		0.77	x	2.24	x	20.32	x	0.4	x	0.8	=	10.09	(74)
North	0.9x		0.77	x	1.5	x	20.32	x	0.4	x	0.8	=	6.76	(74)



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North	0.9x	0.77	x	6.73	x	20.32	x	0.4	x	0.8	=	30.33	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.4	x	0.8	=	17.15	(74)
North	0.9x	0.77	x	1.5	x	34.53	x	0.4	x	0.8	=	11.49	(74)
North	0.9x	0.77	x	6.73	x	34.53	x	0.4	x	0.8	=	51.53	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.4	x	0.8	=	27.55	(74)
North	0.9x	0.77	x	1.5	x	55.46	x	0.4	x	0.8	=	18.45	(74)
North	0.9x	0.77	x	6.73	x	55.46	x	0.4	x	0.8	=	82.78	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.4	x	0.8	=	37.11	(74)
North	0.9x	0.77	x	1.5	x	74.72	x	0.4	x	0.8	=	24.85	(74)
North	0.9x	0.77	x	6.73	x	74.72	x	0.4	x	0.8	=	111.51	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.4	x	0.8	=	39.73	(74)
North	0.9x	0.77	x	1.5	x	79.99	x	0.4	x	0.8	=	26.61	(74)
North	0.9x	0.77	x	6.73	x	79.99	x	0.4	x	0.8	=	119.37	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.4	x	0.8	=	37.1	(74)
North	0.9x	0.77	x	1.5	x	74.68	x	0.4	x	0.8	=	24.84	(74)
North	0.9x	0.77	x	6.73	x	74.68	x	0.4	x	0.8	=	111.45	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.4	x	0.8	=	29.43	(74)
North	0.9x	0.77	x	1.5	x	59.25	x	0.4	x	0.8	=	19.71	(74)
North	0.9x	0.77	x	6.73	x	59.25	x	0.4	x	0.8	=	88.42	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.4	x	0.8	=	20.62	(74)
North	0.9x	0.77	x	1.5	x	41.52	x	0.4	x	0.8	=	13.81	(74)
North	0.9x	0.77	x	6.73	x	41.52	x	0.4	x	0.8	=	61.96	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.4	x	0.8	=	12.02	(74)
North	0.9x	0.77	x	1.5	x	24.19	x	0.4	x	0.8	=	8.05	(74)
North	0.9x	0.77	x	6.73	x	24.19	x	0.4	x	0.8	=	36.1	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.4	x	0.8	=	6.52	(74)
North	0.9x	0.77	x	1.5	x	13.12	x	0.4	x	0.8	=	4.36	(74)
North	0.9x	0.77	x	6.73	x	13.12	x	0.4	x	0.8	=	19.58	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.4	x	0.8	=	4.4	(74)
North	0.9x	0.77	x	1.5	x	8.86	x	0.4	x	0.8	=	2.95	(74)
North	0.9x	0.77	x	6.73	x	8.86	x	0.4	x	0.8	=	13.23	(74)
South	0.9x	0.77	x	1.5	x	46.75	x	0.4	x	0.8	=	15.55	(78)
South	0.9x	0.77	x	1.5	x	76.57	x	0.4	x	0.8	=	25.47	(78)
South	0.9x	0.77	x	1.5	x	97.53	x	0.4	x	0.8	=	32.44	(78)
South	0.9x	0.77	x	1.5	x	110.23	x	0.4	x	0.8	=	36.67	(78)
South	0.9x	0.77	x	1.5	x	114.87	x	0.4	x	0.8	=	38.21	(78)
South	0.9x	0.77	x	1.5	x	110.55	x	0.4	x	0.8	=	36.77	(78)
South	0.9x	0.77	x	1.5	x	108.01	x	0.4	x	0.8	=	35.93	(78)
South	0.9x	0.77	x	1.5	x	104.89	x	0.4	x	0.8	=	34.89	(78)
South	0.9x	0.77	x	1.5	x	101.89	x	0.4	x	0.8	=	33.89	(78)
South	0.9x	0.77	x	1.5	x	82.59	x	0.4	x	0.8	=	27.47	(78)

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South  $0.9 \times \boxed{0.77} \times \boxed{1.5} \times \boxed{55.42} \times \boxed{0.4} \times \boxed{0.8} = \boxed{18.43}$  (78)

South  $0.9 \times \boxed{0.77} \times \boxed{1.5} \times \boxed{40.4} \times \boxed{0.4} \times \boxed{0.8} = \boxed{13.44}$  (78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	40.24	72.65	112.62	165.45	211.69	222.48	209.32	172.45	130.29	83.63	48.89	34.02	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	388.93	419.58	448.98	484.85	514.08	508.3	484.23	452.44	418.87	389.36	374.31	374	(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
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 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.91	0.76	0.54	0.4	0.44	0.7	0.93	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.36	20.46	20.63	20.84	20.96	21	21	21	20.98	20.83	20.57	20.34	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.26	20.27	20.27	20.27	20.28	20.28	20.28	20.29	20.28	20.28	20.27	20.27	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.89	0.71	0.49	0.33	0.37	0.64	0.91	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.41	19.56	19.8	20.09	20.24	20.28	20.28	20.29	20.27	20.09	19.72	19.38	(90)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 

0.56
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 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.94	20.06	20.26	20.51	20.64	20.68	20.68	20.68	20.67	20.5	20.19	19.91	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.94	20.06	20.26	20.51	20.64	20.68	20.68	20.68	20.67	20.5	20.19	19.91	(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	0.99	0.97	0.9	0.74	0.52	0.37	0.41	0.67	0.92	0.98	0.99	(94)
--------	------	------	------	-----	------	------	------	------	------	------	------	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	385.92	413.64	433.93	435.25	377.93	263.58	177.75	185.93	280.73	357.76	367.78	371.71	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m ]

(97)m=	702.39	679.3	615.17	512.85	394.3	264.87	177.84	186.13	287.45	436.57	579.71	699.27	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	235.46	178.53	134.84	55.87	12.18	0	0	0	0	58.63	152.59	243.7	
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Total per year (kWh/year) = Sum(98)1...5,9...12 = 

1071.8
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 (98)

Space heating requirement in kWh/m<sup>2</sup>/year

18.8
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 (99)

### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

## DER WorkSheet: New dwelling design stage

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)
<i>The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.</i>		
Fraction of heat from Community boilers	1	(303a)
Fraction of total space heat from Community boilers <span style="float: right;">(302) x (303a) =</span>	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system	1	(305)
Distribution loss factor (Table 12c) for community heating system	1.1	(306)
<b>Space heating</b>		
<b>kWh/year</b>		
Annual space heating requirement	1071.8	
Space heat from Community boilers <span style="float: right;">(98) x (304a) x (305) x (306) =</span>	1178.98	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0	(308)
Space heating requirement from secondary/supplementary system <span style="float: right;">(98) x (301) x 100 ÷ (308) =</span>	0	(309)
<b>Water heating</b>		
Annual water heating requirement	1897.31	
If DHW from community scheme: Water heat from Community boilers <span style="float: right;">(64) x (303a) x (305) x (306) =</span>	2087.04	(310a)
Electricity used for heat distribution <span style="float: right;">0.01 x [(307a)...(307e) + (310a)...(310e)] =</span>	32.66	(313)
Cooling System Energy Efficiency Ratio	0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0) <span style="float: right;">= (107) ÷ (314) =</span>	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	113	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year <span style="float: right;">=(330a) + (330b) + (330g) =</span>	113	(331)
Energy for lighting (calculated in Appendix L)	260.29	(332)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)				
Efficiency of heat source 1 (%) <span style="float: right;"><i>If there is CHP using two fuels repeat (363) to (366) for the second fuel</i></span>			95	(367a)
CO2 associated with heat source 1 <span style="float: right;">[(307b)+(310b)] x 100 ÷ (367b) x</span>		0.22	=	742.59 (367)
Electrical energy for heat distribution <span style="float: right;">[(313) x</span>		0.52	=	16.95 (372)
Total CO2 associated with community systems <span style="float: right;">(363)...(366) + (368)...(372)</span>			=	759.54 (373)
CO2 associated with space heating (secondary) <span style="float: right;">(309) x</span>		0	=	0 (374)
CO2 associated with water from immersion heater or instantaneous heater <span style="float: right;">(312) x</span>		0.22	=	0 (375)
Total CO2 associated with space and water heating <span style="float: right;">(373) + (374) + (375) =</span>				759.54 (376)
CO2 associated with electricity for pumps and fans within dwelling <span style="float: right;">(331) x</span>		0.52	=	58.65 (378)

## DER WorkSheet: New dwelling design stage

CO2 associated with electricity for lighting	(332)) x	0.52	=	135.09	(379)
<b>Total CO2, kg/year</b>	sum of (376)...(382) =			953.28	(383)
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =			16.72	(384)
<b>EI rating (section 14)</b>				87.48	(385)

# TER WorkSheet: New dwelling design stage

## User Details:

<b>Assessor Name:</b>	John Simpson	<b>Stroma Number:</b>	STRO006273
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.8

Property Address: GT 404 - Be Lean

**Address :** GT 404, Aspen Court, Maitland Park Estate, London, NW3 2EH

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	57	(1a) x	2.6	(2a) =	148.2
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57	(4)			
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =				148.2

### 2. Ventilation rate:

	main heating		secondary heating		other		total		m <sup>3</sup> per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0
Number of open flues	0	+	0	+	0	=	0	x 20 =	0
Number of intermittent fans							2	x 10 =	20
Number of passive vents							0	x 10 =	0
Number of flueless gas fires							0	x 40 =	0

#### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20		÷ (5) =	0.13		(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>						
Number of storeys in the dwelling (ns)				0	(9)	
Additional infiltration				0	[(9)-1]x0.1 = (10)	
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>				0	(11)	
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0				0	(12)	
If no draught lobby, enter 0.05, else enter 0				0	(13)	
Percentage of windows and doors draught stripped				0	(14)	
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =			0	(15)	
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =			0	(16)	
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area				5	(17)	
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)				0.38	(18)	
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>						
Number of sides sheltered				2	(19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.85	(20)	
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =			0.33	(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
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.38
------	------	-----	------	------	------	------	-----	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:  (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)  (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =  (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m= 

0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57
------	------	------	------	------	------	------	------	------	------	------	------

(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 

0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57
------	------	------	------	------	------	------	------	------	------	------	------

(25)

### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,m <sup>2</sup>	U-value W/m <sup>2</sup> K	A X U (W/K)	k-value kJ/m <sup>2</sup> -K	A X k kJ/K
Windows Type 1			<input type="text" value="1.5"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.99"/>		(27)
Windows Type 2			<input type="text" value="2.24"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.97"/>		(27)
Windows Type 3			<input type="text" value="1.5"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.99"/>		(27)
Windows Type 4			<input type="text" value="6.73"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="8.92"/>		(27)
Walls	<input type="text" value="50.8"/>	<input type="text" value="11.97"/>	<input type="text" value="38.83"/>	$x$ <input type="text" value="0.18"/>	$=$ <input type="text" value="6.99"/>	<input type="text"/>	(29)
Roof	<input type="text" value="57"/>	<input type="text" value="0"/>	<input type="text" value="57"/>	$x$ <input type="text" value="0.13"/>	$=$ <input type="text" value="7.41"/>	<input type="text"/>	(30)
Total area of elements, m <sup>2</sup>			<input type="text" value="107.8"/>				(31)
Party wall			<input type="text" value="28.34"/>	$x$ <input type="text" value="0"/>	$=$ <input type="text" value="0"/>	<input type="text"/>	(32)

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[1/U\text{-value}+0.04]$  as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) =  (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) =  (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium  (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  (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) =  (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	28.71	28.54	28.38	27.62	27.48	26.82	26.82	26.69	27.07	27.48	27.77	28.07

(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	64.89	64.73	64.57	63.81	63.66	63	63	62.88	63.26	63.66	63.95	64.25
	Average = Sum(39) <sub>1...12</sub> /12=											
	<input type="text" value="63.81"/> (39)											

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Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1.14	1.14	1.13	1.12	1.12	1.11	1.11	1.1	1.11	1.12	1.12	1.13	
	Average = Sum(40) <sub>1...12</sub> / 12 =											1.12	(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 1.9 (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 79.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	87.14	83.98	80.81	77.64	74.47	71.3	71.3	74.47	77.64	80.81	83.98	87.14	
	Total = Sum(44) <sub>1...12</sub> =											950.67	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	129.23	113.03	116.63	101.68	97.57	84.19	78.02	89.53	90.6	105.58	115.25	125.15	
	Total = Sum(45) <sub>1...12</sub> =											1246.47	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m= 19.38 16.95 17.5 15.25 14.64 12.63 11.7 13.43 13.59 15.84 17.29 18.77 (46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (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) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) x (41)m)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

# TER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	175.83	155.11	163.23	146.78	144.16	129.29	124.61	136.12	135.69	152.18	160.34	171.75	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	175.83	155.11	163.23	146.78	144.16	129.29	124.61	136.12	135.69	152.18	160.34	171.75		
<b>Output from water heater (annual)<sub>1...12</sub></b>												1795.09	(64)	

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	80.25	71.25	76.06	69.88	69.72	64.07	63.22	67.04	66.2	72.38	74.39	78.89	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.78	13.13	10.68	8.08	6.04	5.1	5.51	7.16	9.61	12.21	14.25	15.19	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	165.32	167.04	162.72	153.51	141.89	130.98	123.68	121.97	126.29	135.49	147.11	158.03	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48	(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=	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	107.86	106.03	102.23	97.06	93.71	88.98	84.97	90.11	91.94	97.29	103.33	106.03	(72)
--------	--------	--------	--------	-------	-------	-------	-------	-------	-------	-------	--------	--------	------

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	342.39	340.63	330.05	313.09	296.08	279.49	268.6	273.68	282.28	299.42	319.12	333.69	(73)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub>g</sub> Table 6b	FF Table 6c	Gains (W)	
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">2.24</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">10.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.7</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">7.28</table>	(74)
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">1.5</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">10.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.7</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">4.87</table>	(74)
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">6.73</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">10.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.7</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">21.87</table>	(74)
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">2.24</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">20.32</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.7</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">13.91</table>	(74)
North	0.9x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">1.5</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">20.32</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.63</table>	x <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">0.7</table>	= <table border="1" style="display: inline-table; width: 60px; height: 20px; text-align: center;">9.32</table>	(74)



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North	0.9x	0.77	x	6.73	x	20.32	x	0.63	x	0.7	=	41.8	(74)
North	0.9x	0.77	x	2.24	x	34.53	x	0.63	x	0.7	=	23.64	(74)
North	0.9x	0.77	x	1.5	x	34.53	x	0.63	x	0.7	=	15.83	(74)
North	0.9x	0.77	x	6.73	x	34.53	x	0.63	x	0.7	=	71.02	(74)
North	0.9x	0.77	x	2.24	x	55.46	x	0.63	x	0.7	=	37.97	(74)
North	0.9x	0.77	x	1.5	x	55.46	x	0.63	x	0.7	=	25.43	(74)
North	0.9x	0.77	x	6.73	x	55.46	x	0.63	x	0.7	=	114.08	(74)
North	0.9x	0.77	x	2.24	x	74.72	x	0.63	x	0.7	=	51.15	(74)
North	0.9x	0.77	x	1.5	x	74.72	x	0.63	x	0.7	=	34.25	(74)
North	0.9x	0.77	x	6.73	x	74.72	x	0.63	x	0.7	=	153.67	(74)
North	0.9x	0.77	x	2.24	x	79.99	x	0.63	x	0.7	=	54.76	(74)
North	0.9x	0.77	x	1.5	x	79.99	x	0.63	x	0.7	=	36.67	(74)
North	0.9x	0.77	x	6.73	x	79.99	x	0.63	x	0.7	=	164.51	(74)
North	0.9x	0.77	x	2.24	x	74.68	x	0.63	x	0.7	=	51.12	(74)
North	0.9x	0.77	x	1.5	x	74.68	x	0.63	x	0.7	=	34.23	(74)
North	0.9x	0.77	x	6.73	x	74.68	x	0.63	x	0.7	=	153.59	(74)
North	0.9x	0.77	x	2.24	x	59.25	x	0.63	x	0.7	=	40.56	(74)
North	0.9x	0.77	x	1.5	x	59.25	x	0.63	x	0.7	=	27.16	(74)
North	0.9x	0.77	x	6.73	x	59.25	x	0.63	x	0.7	=	121.86	(74)
North	0.9x	0.77	x	2.24	x	41.52	x	0.63	x	0.7	=	28.42	(74)
North	0.9x	0.77	x	1.5	x	41.52	x	0.63	x	0.7	=	19.03	(74)
North	0.9x	0.77	x	6.73	x	41.52	x	0.63	x	0.7	=	85.39	(74)
North	0.9x	0.77	x	2.24	x	24.19	x	0.63	x	0.7	=	16.56	(74)
North	0.9x	0.77	x	1.5	x	24.19	x	0.63	x	0.7	=	11.09	(74)
North	0.9x	0.77	x	6.73	x	24.19	x	0.63	x	0.7	=	49.75	(74)
North	0.9x	0.77	x	2.24	x	13.12	x	0.63	x	0.7	=	8.98	(74)
North	0.9x	0.77	x	1.5	x	13.12	x	0.63	x	0.7	=	6.01	(74)
North	0.9x	0.77	x	6.73	x	13.12	x	0.63	x	0.7	=	26.98	(74)
North	0.9x	0.77	x	2.24	x	8.86	x	0.63	x	0.7	=	6.07	(74)
North	0.9x	0.77	x	1.5	x	8.86	x	0.63	x	0.7	=	4.06	(74)
North	0.9x	0.77	x	6.73	x	8.86	x	0.63	x	0.7	=	18.23	(74)
South	0.9x	0.77	x	1.5	x	46.75	x	0.63	x	0.7	=	21.43	(78)
South	0.9x	0.77	x	1.5	x	76.57	x	0.63	x	0.7	=	35.1	(78)
South	0.9x	0.77	x	1.5	x	97.53	x	0.63	x	0.7	=	44.71	(78)
South	0.9x	0.77	x	1.5	x	110.23	x	0.63	x	0.7	=	50.53	(78)
South	0.9x	0.77	x	1.5	x	114.87	x	0.63	x	0.7	=	52.66	(78)
South	0.9x	0.77	x	1.5	x	110.55	x	0.63	x	0.7	=	50.68	(78)
South	0.9x	0.77	x	1.5	x	108.01	x	0.63	x	0.7	=	49.51	(78)
South	0.9x	0.77	x	1.5	x	104.89	x	0.63	x	0.7	=	48.09	(78)
South	0.9x	0.77	x	1.5	x	101.89	x	0.63	x	0.7	=	46.71	(78)
South	0.9x	0.77	x	1.5	x	82.59	x	0.63	x	0.7	=	37.86	(78)

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South  $0.9 \times \boxed{0.77} \times \boxed{1.5} \times \boxed{55.42} \times \boxed{0.63} \times \boxed{0.7} = \boxed{25.4}$  (78)

South  $0.9 \times \boxed{0.77} \times \boxed{1.5} \times \boxed{40.4} \times \boxed{0.63} \times \boxed{0.7} = \boxed{18.52}$  (78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	55.46	100.12	155.2	228.01	291.73	306.61	288.46	237.66	179.55	115.26	67.38	46.88	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	397.85	440.75	485.25	541.1	587.81	586.11	557.06	511.34	461.83	414.68	386.5	380.57	(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
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 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.84	0.65	0.49	0.55	0.81	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.86	20	20.24	20.57	20.84	20.97	20.99	20.99	20.9	20.57	20.16	19.84	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.97	19.97	19.97	19.99	19.99	20	20	20	19.99	19.99	19.98	19.98	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.93	0.79	0.57	0.38	0.44	0.74	0.95	0.99	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.47	18.67	19.02	19.49	19.83	19.98	19.99	19.99	19.91	19.49	18.91	18.44	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.56
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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.24	19.41	19.7	20.09	20.39	20.53	20.55	20.55	20.46	20.09	19.61	19.22	(92)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.24	19.41	19.7	20.09	20.39	20.53	20.55	20.55	20.46	20.09	19.61	19.22	(93)
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### 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	0.99	0.97	0.93	0.81	0.61	0.44	0.5	0.78	0.95	0.99	0.99	(94)
--------	------	------	------	------	------	------	------	-----	------	------	------	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	395.27	435.67	472.94	502.48	476.67	359.47	246.74	256.85	358.07	393.85	381.64	378.57	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m ]

(97)m=	969.82	939.16	852.08	713.84	553.31	373.38	248.86	260.77	402.43	604.05	799.87	965.05	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	427.47	338.34	282.08	152.17	57.02	0	0	0	0	156.39	301.13	436.34	(98)
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Total per year (kWh/year) = Sum(98)...59...12 =

2150.93
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Space heating requirement in kWh/m<sup>2</sup>/year

37.74
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### 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

Fraction of space heat from secondary/supplementary system

0
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(201)

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Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement (calculated above)	427.47	338.34	282.08	152.17	57.02	0	0	0	0	156.39	301.13	436.34	kWh/year

(211)m = {[ (98)m x (204) ] } x 100 ÷ (206)			(211)											
	457.18	361.86	301.69	162.75	60.98	0	0	0	0	167.26	322.06	466.67		
	Total (kWh/year) = Sum(211) <sub>1..5,10..12</sub> =												2300.46	(211)

Space heating fuel (secondary), kWh/month														
= {[ (98)m x (201) ] } x 100 ÷ (208)														
(215)m =	0	0	0	0	0	0	0	0	0	0	0	0		
	Total (kWh/year) = Sum(215) <sub>1..5,10..12</sub> =												0	(215)

### Water heating

Output from water heater (calculated above)													
	175.83	155.11	163.23	146.78	144.16	129.29	124.61	136.12	135.69	152.18	160.34	171.75	

Efficiency of water heater		79.8	(216)										
(217)m =	87.1	86.84	86.26	84.91	82.57	79.8	79.8	79.8	79.8	84.89	86.47	87.2	(217)

Fuel for water heating, kWh/month														
(219)m = (64)m x 100 ÷ (217)m														
(219)m =	201.88	178.62	189.23	172.86	174.6	162.01	156.16	170.58	170.04	179.27	185.43	196.97		
	Total = Sum(219a) <sub>1..12</sub> =												2137.64	(219)

### Annual totals

	<b>kWh/year</b>	<b>kWh/year</b>
Space heating fuel used, main system 1		2300.46
Water heating fuel used		2137.64

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		261	(232)

### 12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	496.9	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	461.73	(264)
Space and water heating	(261) + (262) + (263) + (264) =			958.63	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	135.46	(268)

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Total CO2, kg/year

sum of (265)...(271) =

1133.02

(272)

**TER =**

19.88

(273)