

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.9
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Project Information:

Assessed By: Zahid Ashraf (STRO001082)

Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 51.02m²

Site Reference : Hermitage Lane

Plot Reference: Plot 26

Address :

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas (c)

Fuel factor: 1.00 (mains gas (c))

Target Carbon Dioxide Emission Rate (TER) 18.03 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 11.42 kg/m² **OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 39.8 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 33.7 kWh/m² **OK**

2 Fabric U-values

Element	Average	Highest	
External wall	0.14 (max. 0.30)	0.15 (max. 0.70)	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals 3.00 (design value)

Maximum 10.0 **OK**

4 Heating efficiency

Main Heating system: Community heating schemes - mains gas

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

6 Controls

Space heating controls Charging system linked to use of community heating, programmer and at least two room thermostats **OK**

Hot water controls: No cylinder thermostat
No cylinder

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7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Continuous supply and extract system		
Specific fan power:	0.91	
Maximum	1.5	OK
MVHR efficiency:	93%	
Minimum	70%	OK

9 Summertime temperature

Overheating risk (Thames valley):	Medium	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: North East	8.65m ²	
Ventilation rate:	4.00	

10 Key features

Air permeability	3.0 m ³ /m ² h
Community heating, heat from boilers – mains gas	
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Zahid Ashraf	Stroma Number:	STRO001082
Software Name:	Stroma FSAP 2012	Software Version:	Version: 1.0.5.9

Property Address: Plot 26

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	51.02	(1a) x	2.5	(2a) =	127.55 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.02	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.55 (5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.12 (21)

Infiltration rate modified for monthly wind speed

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14
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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) =

79.05 (23c)

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

(24a)m=

0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24
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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)m² x 0.5]

(24d)m=

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

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

(25)m=

0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24
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 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K
Doors			2	1.4	2.8		(26)
Windows			8.651	x1/[1/(1.4)+0.04]	11.47		(27)
Walls Type1	24.16	8.65	15.51	x 0.15	2.33		(29)
Walls Type2	18.88	2	16.88	x 0.14	2.39		(29)
Total area of elements, m ²			43.04				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2
 ** include the areas on both sides of internal walls and partitions

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

18.98

 (33)

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

453.39

 (34)

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

100

 (35)

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

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

4.92

 (36)

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

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

23.9

 (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
10.65	10.53	10.4	9.79	9.67	9.06	9.06	8.94	9.3	9.67	9.91	10.16

 (38)

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

(39)m=

34.55	34.43	34.31	33.7	33.57	32.96	32.96	32.84	33.21	33.57	33.82	34.06
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 Average = Sum(39)_{1...12} /12=

33.67

 (39)

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

(40)m=

0.68	0.67	0.67	0.66	0.66	0.65	0.65	0.64	0.65	0.66	0.66	0.67
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 Average = Sum(40)_{1...12} /12=

0.66

 (40)

DER WorkSheet: New dwelling design stage

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N (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 (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=	86.91	83.75	80.59	77.43	74.27	71.1	71.1	74.27	77.43	80.59	83.75	86.91	
Total = Sum(44) _{1...12} =												<input style="width: 100px;" type="text" value="948.07"/>	(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=	128.88	112.72	116.32	101.41	97.3	83.96	77.81	89.28	90.35	105.29	114.94	124.81	
Total = Sum(45) _{1...12} =												<input style="width: 100px;" type="text" value="1243.06"/>	(45)

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

(46)m=

19.33	16.91	17.45	15.21	14.6	12.59	11.67	13.39	13.55	15.79	17.24	18.72
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 (46)

Water storage loss:

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

Temperature factor from Table 2b (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a (52)

Temperature factor from Table 2b (53)

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

Enter (50) or (54) in (55) (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 (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 x (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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DER WorkSheet: New dwelling design stage

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

(62)m=	184.16	162.65	171.59	154.9	152.58	137.46	133.08	144.56	143.84	160.57	168.43	180.09	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

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

(64)m=	184.16	162.65	171.59	154.9	152.58	137.46	133.08	144.56	143.84	160.57	168.43	180.09		
Output from water heater (annual)_{1...12}												(64)	1893.9	

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=	87.07	77.42	82.9	76.51	76.57	70.71	70.09	73.91	72.84	79.23	81.01	85.72	(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=	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	(66)

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

(67)m=	13.79	12.25	9.96	7.54	5.64	4.76	5.14	6.68	8.97	11.39	13.29	14.17	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	149.89	151.44	147.52	139.18	128.65	118.75	112.13	110.58	114.5	122.84	133.37	143.27	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	(69)
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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=	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	(71)
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Water heating gains (Table 5)

(72)m=	117.03	115.21	111.42	106.27	102.92	98.21	94.21	99.34	101.16	106.49	112.52	115.22	(72)
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Total internal gains = **(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m**

(73)m=	329.51	327.7	317.71	301.79	286.01	270.52	260.29	265.4	273.43	289.53	307.99	321.47	(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 ²	x	Flux Table 6a	x	g _o Table 6b	x	FF Table 6c	=	Gains (W)	
Northeast 0.9x	0.77	x	8.65	x	11.28	x	0.63	x	0.7	=	29.83	(75)
Northeast 0.9x	0.77	x	8.65	x	22.97	x	0.63	x	0.7	=	60.72	(75)
Northeast 0.9x	0.77	x	8.65	x	41.38	x	0.63	x	0.7	=	109.4	(75)
Northeast 0.9x	0.77	x	8.65	x	67.96	x	0.63	x	0.7	=	179.67	(75)
Northeast 0.9x	0.77	x	8.65	x	91.35	x	0.63	x	0.7	=	241.51	(75)
Northeast 0.9x	0.77	x	8.65	x	97.38	x	0.63	x	0.7	=	257.47	(75)
Northeast 0.9x	0.77	x	8.65	x	91.1	x	0.63	x	0.7	=	240.86	(75)
Northeast 0.9x	0.77	x	8.65	x	72.63	x	0.63	x	0.7	=	192.02	(75)

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Northeast 0.9x	0.77	x	8.65	x	50.42	x	0.63	x	0.7	=	133.31	(75)
Northeast 0.9x	0.77	x	8.65	x	28.07	x	0.63	x	0.7	=	74.21	(75)
Northeast 0.9x	0.77	x	8.65	x	14.2	x	0.63	x	0.7	=	37.53	(75)
Northeast 0.9x	0.77	x	8.65	x	9.21	x	0.63	x	0.7	=	24.36	(75)

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

(83)m=	29.83	60.72	109.4	179.67	241.51	257.47	240.86	192.02	133.31	74.21	37.53	24.36	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	359.34	388.42	427.11	481.46	527.51	527.99	501.15	457.42	406.74	363.73	345.52	345.83	(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=	0.93	0.9	0.85	0.72	0.56	0.39	0.29	0.33	0.53	0.78	0.89	0.93	(86)

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

(87)m=	19.98	20.15	20.43	20.75	20.92	20.98	21	20.99	20.95	20.72	20.32	19.95	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.36	20.36	20.37	20.38	20.38	20.39	20.39	20.39	20.38	20.38	20.37	20.37	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.92	0.89	0.83	0.7	0.53	0.36	0.25	0.28	0.49	0.75	0.88	0.93	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.99	19.22	19.62	20.06	20.29	20.37	20.39	20.39	20.33	20.03	19.48	18.95	(90)
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fLA = Living area ÷ (4) = 0.45 (91)

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

(92)m=	19.43	19.64	19.98	20.37	20.57	20.65	20.66	20.66	20.61	20.34	19.86	19.41	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.43	19.64	19.98	20.37	20.57	20.65	20.66	20.66	20.61	20.34	19.86	19.41	(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=	0.91	0.88	0.82	0.7	0.54	0.37	0.27	0.3	0.51	0.75	0.87	0.92	(94)
--------	------	------	------	-----	------	------	------	-----	------	------	------	------	------

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

(95)m=	326.01	341.84	350.22	335.82	282.28	196.51	133.29	138.94	206.9	272.19	300.31	316.54	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	522.95	507.53	462.64	386.53	297.95	199.41	133.88	139.93	216.26	327.11	431.53	517.95	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	146.52	111.34	83.64	36.51	11.66	0	0	0	0	40.86	94.48	149.85	(98)
--------	--------	--------	-------	-------	-------	---	---	---	---	-------	-------	--------	------

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 674.87 (98)

Space heating requirement in kWh/m²/year

13.23 (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)
<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		1.05	(306)
Space heating		kWh/year	
Annual space heating requirement		674.87	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	708.61	(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		1893.9	
If DHW from community scheme:			
Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1988.6	(310a)
Electricity used for heat distribution	0.01 x [(307a)...(307e) + (310a)...(310e)] =	26.97	(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		177.01	(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) =	177.01	(331)
Energy for lighting (calculated in Appendix L)		243.51	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.71	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

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			94
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	619.78
Electrical energy for heat distribution	[(313) x	0.52	=	14
Total CO2 associated with community systems	(363)...(366) + (368)...(372)		=	633.78
CO2 associated with space heating (secondary)	(309) x	0	=	0

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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) =			633.78	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331) x	0.52	=	91.87	(378)
CO2 associated with electricity for lighting	(332)) x	0.52	=	126.38	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-269.21	(380)
Total CO2, kg/year	sum of (376)...(382) =			582.82	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			11.42	(384)
EI rating (section 14)				91.87	(385)

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 28 October 2020

Property Details: Plot 26

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	No
Number of storeys:	1
Front of dwelling faces:	South West
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Low
Night ventilation:	False
Blinds, curtains, shutters:	
Ventilation rate during hot weather (ach):	4 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	168.37	(P1)
Transmission heat loss coefficient:	23.9	
Summer heat loss coefficient:	192.28	(P2)

Overhangs:

Orientation:	Ratio:	Z_overhangs:
North East (NE)	0	1

Solar shading:

Orientation:	Z blinds:	Solar access:	Overhangs:	Z summer:	
North East (NE)	1	0.9	1	0.9	(P8)

Solar gains:

Orientation		Area	Flux	g_	FF	Shading	Gains
North East (NE)	0.9 x	8.65	98.85	0.63	0.7	0.9	305.45
						Total	305.45 (P3/P4)

Internal gains:

	June	July	August
Internal gains	368.79	355.87	362.54
Total summer gains	698.54	661.33	612.43 (P5)
Summer gain/loss ratio	3.63	3.44	3.19 (P6)
Mean summer external temperature (Thames valley)	16	17.9	17.8
Thermal mass temperature increment	1.3	1.3	1.3
Threshold temperature	20.93	22.64	22.29 (P7)
Likelihood of high internal temperature	Slight	Medium	Medium

Assessment of likelihood of high internal temperature: Medium

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Zahid Ashraf	Stroma Number:	STRO001082
Software Name:	Stroma FSAP 2012	Software Version:	Version: 1.0.5.9

Property Address: Plot 26

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	51.02	(1a) x	2.5	(2a) =	127.55 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.02	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.55 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total			m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							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) =	0.16	(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			3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.31	(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) =		0.24	(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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DFEE WorkSheet: New dwelling design stage

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

0.3	0.3	0.29	0.26	0.26	0.23	0.23	0.22	0.24	0.26	0.27	0.28
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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=

0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.52	0.53	0.53	0.54	0.54
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 (24d)

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

(25)m=

0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.52	0.53	0.53	0.54	0.54
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 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K
Doors			2	1.4	2.8		(26)
Windows			8.651	x1/[1/(1.4)+0.04]	11.47		(27)
Walls Type1	24.16	8.65	15.51	x 0.15	2.33		(29)
Walls Type2	18.88	2	16.88	x 0.14	2.39		(29)
Total area of elements, m ²			43.04				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2
 ** include the areas on both sides of internal walls and partitions

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

18.98

 (33)

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

453.39

 (34)

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

100

 (35)

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

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

4.92

 (36)

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

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

23.9

 (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
22.98	22.91	22.83	22.49	22.42	22.12	22.12	22.06	22.24	22.42	22.55	22.69

 (38)

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

(39)m=

46.89	46.81	46.74	46.39	46.33	46.03	46.03	45.97	46.14	46.33	46.46	46.59
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 Average = Sum(39)_{1...12} /12=

46.39

 (39)

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

(40)m=

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

0.91

 (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 (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 (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=	86.91	83.75	80.59	77.43	74.27	71.1	71.1	74.27	77.43	80.59	83.75	86.91	
Total = Sum(44) _{1...12} =												948.07	(44)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	128.88	112.72	116.32	101.41	97.3	83.96	77.81	89.28	90.35	105.29	114.94	124.81	
Total = Sum(45) _{1...12} =												1243.06	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

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

Temperature factor from Table 2b (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a (52)

Temperature factor from Table 2b (53)

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

Enter (50) or (54) in (55) (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=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 (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=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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=	109.55	95.81	98.87	86.2	82.71	71.37	66.13	75.89	76.8	89.5	97.7	106.09	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

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

(64)m=	109.55	95.81	98.87	86.2	82.71	71.37	66.13	75.89	76.8	89.5	97.7	106.09		
Output from water heater (annual)_{1...12}												(64)	1056.6	

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=	27.39	23.95	24.72	21.55	20.68	17.84	16.53	18.97	19.2	22.37	24.42	26.52	(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=	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	(66)

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

(67)m=	13.79	12.25	9.96	7.54	5.64	4.76	5.14	6.68	8.97	11.39	13.29	14.17	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	149.89	151.44	147.52	139.18	128.65	118.75	112.13	110.58	114.5	122.84	133.37	143.27	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	(69)
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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=	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	(71)
---------------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------------

Water heating gains (Table 5)

(72)m=	36.81	35.64	33.22	29.93	27.79	24.78	22.22	25.5	26.67	30.07	33.92	35.65	(72)
---------------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------------

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

(73)m=	249.29	248.14	239.51	225.45	210.88	197.09	188.3	191.57	198.94	213.11	229.39	241.9	(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 ²	x	Flux Table 6a	x	g _g Table 6b	x	FF Table 6c	=	Gains (W)	
Northeast 0.9x	0.77	x	8.65	x	11.28	x	0.63	x	0.7	=	29.83	(75)
Northeast 0.9x	0.77	x	8.65	x	22.97	x	0.63	x	0.7	=	60.72	(75)
Northeast 0.9x	0.77	x	8.65	x	41.38	x	0.63	x	0.7	=	109.4	(75)
Northeast 0.9x	0.77	x	8.65	x	67.96	x	0.63	x	0.7	=	179.67	(75)
Northeast 0.9x	0.77	x	8.65	x	91.35	x	0.63	x	0.7	=	241.51	(75)
Northeast 0.9x	0.77	x	8.65	x	97.38	x	0.63	x	0.7	=	257.47	(75)
Northeast 0.9x	0.77	x	8.65	x	91.1	x	0.63	x	0.7	=	240.86	(75)
Northeast 0.9x	0.77	x	8.65	x	72.63	x	0.63	x	0.7	=	192.02	(75)

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Northeast 0.9x	0.77	x	8.65	x	50.42	x	0.63	x	0.7	=	133.31	(75)
Northeast 0.9x	0.77	x	8.65	x	28.07	x	0.63	x	0.7	=	74.21	(75)
Northeast 0.9x	0.77	x	8.65	x	14.2	x	0.63	x	0.7	=	37.53	(75)
Northeast 0.9x	0.77	x	8.65	x	9.21	x	0.63	x	0.7	=	24.36	(75)

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

(83)m=	29.83	60.72	109.4	179.67	241.51	257.47	240.86	192.02	133.31	74.21	37.53	24.36	(83)
--------	-------	-------	-------	--------	--------	--------	--------	--------	--------	-------	-------	-------	------

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

(84)m=	279.12	308.86	348.91	405.12	452.38	454.56	429.16	383.58	332.24	287.31	266.93	266.26	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.97	0.96	0.93	0.86	0.73	0.57	0.45	0.51	0.74	0.9	0.96	0.97	(86)

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

(87)m=	19.05	19.26	19.65	20.18	20.62	20.87	20.96	20.94	20.72	20.15	19.51	19	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	------

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

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

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

(89)m=	0.97	0.95	0.92	0.84	0.7	0.52	0.37	0.43	0.68	0.89	0.95	0.97	(89)
--------	------	------	------	------	-----	------	------	------	------	------	------	------	------

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

(90)m=	18.35	18.55	18.95	19.46	19.87	20.08	20.14	20.13	19.96	19.44	18.81	18.31	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.45 (91)

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

(92)m=	18.67	18.87	19.27	19.79	20.21	20.44	20.51	20.5	20.3	19.76	19.13	18.62	(92)
--------	-------	-------	-------	-------	-------	-------	-------	------	------	-------	-------	-------	------

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

(93)m=	18.67	18.87	19.27	19.79	20.21	20.44	20.51	20.5	20.3	19.76	19.13	18.62	(93)
--------	-------	-------	-------	-------	-------	-------	-------	------	------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.96	0.94	0.91	0.83	0.7	0.54	0.4	0.46	0.69	0.88	0.94	0.96	(94)
--------	------	------	------	------	-----	------	-----	------	------	------	------	------	------

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

(95)m=	267.3	291.06	316.52	335.5	315.95	243.71	172.43	176.73	230.71	251.57	251.31	256.27	(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=	673.58	654.04	596.61	505.11	394.13	268.77	180.02	188.27	286.29	424.43	558.78	671.95	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	302.27	243.93	208.38	122.12	58.16	0	0	0	0	128.61	221.38	309.26	
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	--

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 1594.11 (98)

Space heating requirement in kWh/m²/year

31.24	(99)
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8c. Space cooling requirement

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

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

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

(100)m=	0	0	0	0	0	432.64	340.59	349.37	0	0	0	0	(100)
---------	---	---	---	---	---	--------	--------	--------	---	---	---	---	-------

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.86	0.9	0.88	0	0	0	0	(101)
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Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	371.35	307.53	305.74	0	0	0	0	(102)
---------	---	---	---	---	---	--------	--------	--------	---	---	---	---	-------

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

(103)m=	0	0	0	0	0	596.3	565.41	513.13	0	0	0	0	(103)
---------	---	---	---	---	---	-------	--------	--------	---	---	---	---	-------

Space cooling requirement for month, whole dwelling, continuous (kWh) = $0.024 \times [(103)m - (102)m] \times (41)m$
 set (104)m to zero if (104)m < 3 x (98)m

(104)m=	0	0	0	0	0	161.96	191.86	154.3	0	0	0	0	
---------	---	---	---	---	---	--------	--------	-------	---	---	---	---	--

Total = Sum(104) = 508.12 (104)

Cooled fraction

f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

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

Total = Sum(106) = 0 (106)

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

(107)m=	0	0	0	0	0	40.49	47.97	38.57	0	0	0	0	
---------	---	---	---	---	---	-------	-------	-------	---	---	---	---	--

Total = Sum(107) = 127.03 (107)

Space cooling requirement in kWh/m²/year

(107) ÷ (4) = 2.49 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 33.73 (109)

SAP Input

Property Details: Plot 26

Address:
 Located in: England
 Region: Thames valley
 UPRN:
 Date of assessment: 08 July 2020
 Date of certificate: 28 October 2020
 Assessment type: New dwelling design stage
 Transaction type: New dwelling
 Tenure type: Unknown
 Related party disclosure: No related party
 Thermal Mass Parameter: Indicative Value Low
 Water use <= 125 litres/person/day: False
 PCDF Version: 466

Property description:

Dwelling type: Flat
 Detachment:
 Year Completed: 2020
 Floor Location: Floor area: Storey height:
 Floor 0 51.022 m² 2.5 m
 Living area: 23.04 m² (fraction 0.452)
 Front of dwelling faces: South West

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
SW	Manufacturer	Solid			
NE	Manufacturer	Windows	double-glazed	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
SW	mm	0	0	1.4	2	1
NE	16mm or more	0.7	0.63	1.4	8.651	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
SW		Corridor Wall	South West	0	0
NE		External Wall	North East	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
External Wall	24.161	8.65	15.51	0.15	0	False	N/A
Corridor Wall	18.875	2	16.88	0.15	0.4	False	N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.1144

Length	Psi-value		
4.795	0.289	E2	Other lintels (including other steel lintels)
13.2	0.047	E4	Jamb
31.584	0.064	E7	Party floor between dwellings (in blocks of flats)
5.45	0.055	E18	Party wall between dwellings

SAP Input

5.45	0.109	E25	Staggered party wall between dwellings
26.898	0	P3	Intermediate floor between dwellings (in blocks of flats)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery
	Number of wet rooms: Kitchen + 1
	Ductwork: Insulation, rigid
	Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	3

Main heating system:

Main heating system:	Community heating schemes
	Heat source: Community boilers
	heat from boilers – mains gas, heat fraction 1, efficiency 94
	Piping >=1991, pre-insulated, low temp, variable flow
	Central heating pump : 2013 or later
	Design flow temperature: Unknown
	Boiler interlock: Yes

Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and at least two room thermostats
	Control code: 2312

Secondary heating system:

Secondary heating system:	None
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Water heating:

Water heating:	From main heating system
	Water code: 901
	Fuel :mains gas
	No hot water cylinder
	Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	<u>Photovoltaic 1</u>
	Installed Peak power: 0.63
	Tilt of collector: 30°
	Overshading: None or very little
	Collector Orientation: South West
Assess Zero Carbon Home:	No

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Zahid Ashraf	Stroma Number:	STRO001082
Software Name:	Stroma FSAP 2012	Software Version:	Version: 1.0.5.9

Property Address: Plot 26

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	51.02	(1a) x	2.5	(2a) =	127.55 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.02	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.55 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							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) =	0.16 (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			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (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
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

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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TFEE WorkSheet: New dwelling design stage

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

0.4	0.39	0.39	0.35	0.34	0.3	0.3	0.29	0.32	0.34	0.35	0.37
-----	------	------	------	------	-----	-----	------	------	------	------	------

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=

0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
------	------	------	------	------	------	------	------	------	------	------	------

 (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 ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K
Doors			2	1	2		(26)
Windows			8.651	x1/[1/(1.4)+0.04]	11.47		(27)
Walls Type1	24.16	8.65	15.51	x 0.18	2.79		(29)
Walls Type2	18.88	2	16.88	x 0.18	3.04		(29)
Total area of elements, m ²			43.04				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2
 ** include the areas on both sides of internal walls and partitions

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

19.3

 (33)

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

453.39

 (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

3.76

 (36)

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

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

23.06

 (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
24.45	24.32	24.19	23.58	23.46	22.93	22.93	22.84	23.14	23.46	23.69	23.93

 (38)

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

(39)m=

47.51	47.38	47.25	46.64	46.53	46	46	45.9	46.2	46.53	46.76	47
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 Average = Sum(39)_{1...12} /12=

46.64

 (39)

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

(40)m=

0.93	0.93	0.93	0.91	0.91	0.9	0.9	0.9	0.91	0.91	0.92	0.92
------	------	------	------	------	-----	-----	-----	------	------	------	------

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

0.91

 (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 (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 (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=	82.56	79.56	76.56	73.55	70.55	67.55	67.55	70.55	73.55	76.56	79.56	82.56	
Total = Sum(44)_{1...12} =												<input style="width: 100px;" type="text" value="900.66"/>	(44)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	122.44	107.08	110.5	96.34	92.44	79.77	73.91	84.82	85.83	100.03	109.19	118.57	
Total = Sum(45)_{1...12} =												<input style="width: 100px;" type="text" value="1180.91"/>	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

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

Temperature factor from Table 2b (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a (52)

Temperature factor from Table 2b (53)

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

Enter (50) or (54) in (55) (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=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 (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=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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=	104.07	91.02	93.92	81.89	78.57	67.8	62.83	72.1	72.96	85.02	92.81	100.79	(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=	104.07	91.02	93.92	81.89	78.57	67.8	62.83	72.1	72.96	85.02	92.81	100.79		
Output from water heater (annual)_{1...12}												(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=	26.02	22.76	23.48	20.47	19.64	16.95	15.71	18.02	18.24	21.26	23.2	25.2	(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=	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	(66)

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

(67)m=	13.79	12.25	9.96	7.54	5.64	4.76	5.14	6.68	8.97	11.39	13.29	14.17	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	149.89	151.44	147.52	139.18	128.65	118.75	112.13	110.58	114.5	122.84	133.37	143.27	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	(69)
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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=	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	(71)
---------------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------------

Water heating gains (Table 5)

(72)m=	34.97	33.86	31.56	28.43	26.4	23.54	21.11	24.23	25.33	28.57	32.23	33.87	(72)
---------------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------------

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

(73)m=	247.45	246.35	237.85	223.96	209.49	195.85	187.19	190.29	197.6	211.61	227.7	240.12	(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 ²	x	Flux Table 6a	x	g _g Table 6b	x	FF Table 6c	=	Gains (W)	
Northeast 0.9x	0.77	x	8.65	x	11.28	x	0.63	x	0.7	=	29.83	(75)
Northeast 0.9x	0.77	x	8.65	x	22.97	x	0.63	x	0.7	=	60.72	(75)
Northeast 0.9x	0.77	x	8.65	x	41.38	x	0.63	x	0.7	=	109.4	(75)
Northeast 0.9x	0.77	x	8.65	x	67.96	x	0.63	x	0.7	=	179.67	(75)
Northeast 0.9x	0.77	x	8.65	x	91.35	x	0.63	x	0.7	=	241.51	(75)
Northeast 0.9x	0.77	x	8.65	x	97.38	x	0.63	x	0.7	=	257.47	(75)
Northeast 0.9x	0.77	x	8.65	x	91.1	x	0.63	x	0.7	=	240.86	(75)
Northeast 0.9x	0.77	x	8.65	x	72.63	x	0.63	x	0.7	=	192.02	(75)

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Northeast 0.9x	0.77	x	8.65	x	50.42	x	0.63	x	0.7	=	133.31	(75)
Northeast 0.9x	0.77	x	8.65	x	28.07	x	0.63	x	0.7	=	74.21	(75)
Northeast 0.9x	0.77	x	8.65	x	14.2	x	0.63	x	0.7	=	37.53	(75)
Northeast 0.9x	0.77	x	8.65	x	9.21	x	0.63	x	0.7	=	24.36	(75)

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

(83)m=	29.83	60.72	109.4	179.67	241.51	257.47	240.86	192.02	133.31	74.21	37.53	24.36	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	277.28	307.08	347.25	403.62	450.99	453.32	428.05	382.31	330.91	285.81	265.23	264.48	(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	1	0.99	0.96	0.84	0.63	0.47	0.55	0.84	0.98	1	1	(86)

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

(87)m=	20.01	20.12	20.35	20.66	20.9	20.99	21	21	20.92	20.61	20.26	19.99	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.14	20.15	20.16	20.16	20.17	20.17	20.17	20.16	20.16	20.15	20.15	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.94	0.79	0.56	0.38	0.45	0.78	0.97	1	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.23	19.35	19.57	19.88	20.09	20.16	20.17	20.17	20.12	19.84	19.49	19.22	(90)
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fLA = Living area ÷ (4) = 0.45 (91)

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

(92)m=	19.58	19.7	19.92	20.23	20.45	20.53	20.54	20.54	20.48	20.19	19.84	19.57	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.58	19.7	19.92	20.23	20.45	20.53	20.54	20.54	20.48	20.19	19.84	19.57	(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=	1	1	0.99	0.95	0.81	0.59	0.42	0.49	0.81	0.97	1	1	(94)

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

(95)m=	276.73	305.84	342.94	381.77	365.95	267.92	180.76	188.74	266.52	278.63	264.13	264.08	(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=	726.03	701.05	634.02	528.49	407.29	272.88	181.3	190.06	294.88	446.02	595.51	722.19	(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=	334.28	265.58	216.56	105.64	30.76	0	0	0	0	124.53	238.6	340.84	(98)
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 1656.79 (98)

Space heating requirement in kWh/m²/year

32.47	(99)
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8c. Space cooling requirement

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

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

(100)m=	0	0	0	0	0	432.38	340.38	348.84	0	0	0	0	(100)
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Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.96	0.98	0.97	0	0	0	0	(101)
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Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	413.82	334.14	337.59	0	0	0	0	(102)
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Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	595.06	564.3	511.86	0	0	0	0	(103)
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Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 x (98)m

(104)m=	0	0	0	0	0	130.49	171.24	129.66	0	0	0	0	
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Total = Sum(104) =	431.39	(104)
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Cooled fraction

f C = cooled area ÷ (4) =	1	(105)
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Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
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Total = Sum(106) =	0	(106)
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Space cooling requirement for month = (104)m x (105) x (106)m

(107)m=	0	0	0	0	0	32.62	42.81	32.41	0	0	0	0	
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Total = Sum(107) =	107.85	(107)
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Space cooling requirement in kWh/m²/year

(107) ÷ (4) =	2.11	(108)
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8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	34.59	(109)
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Target Fabric Energy Efficiency (TFEE)		39.77	(109)
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SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Zahid Ashraf	Stroma Number:	STRO001082
Software Name:	Stroma FSAP 2012	Software Version:	Version: 1.0.5.9

Property Address: Plot 26

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	51.02	(1a) x	2.5	(2a) =	127.55 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.02	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.55 (5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.12 (21)

Infiltration rate modified for monthly wind speed

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14
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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) =

79.05 (23c)

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

(24a)m= 0.25 0.25 0.25 0.23 0.23 0.22 0.22 0.21 0.22 0.23 0.24 0.24 (24a)

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

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

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

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

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

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

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

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

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

(25)m= 0.25 0.25 0.25 0.23 0.23 0.22 0.22 0.21 0.22 0.23 0.24 0.24 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K
Doors			2	1.4	2.8		(26)
Windows			8.651	1/[1/(1.4)+0.04]	11.47		(27)
Walls Type1	24.16	8.65	15.51	0.15	2.33		(29)
Walls Type2	18.88	2	16.88	0.14	2.39		(29)
Total area of elements, m ²			43.04				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 18.98 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 453.39 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 4.92 (36)

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

Total fabric heat loss (33) + (36) = 23.9 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	10.65	10.53	10.4	9.79	9.67	9.06	9.06	8.94	9.3	9.67	9.91	10.16

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

(39)m= 34.55 34.43 34.31 33.7 33.57 32.96 32.96 32.84 33.21 33.57 33.82 34.06
Average = Sum(39)_{1...12} /12= 33.67 (39)

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

(40)m= 0.68 0.67 0.67 0.66 0.66 0.65 0.65 0.64 0.65 0.66 0.66 0.67
Average = Sum(40)_{1...12} /12= 0.66 (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 (42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$ (43)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$

(44)m=	86.91	83.75	80.59	77.43	74.27	71.1	71.1	74.27	77.43	80.59	83.75	86.91	
Total = Sum(44)_{1...12} =												<input style="width: 100px;" type="text" value="948.07"/>	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times nm \times DTm / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.88	112.72	116.32	101.41	97.3	83.96	77.81	89.28	90.35	105.29	114.94	124.81	
Total = Sum(45)_{1...12} =												<input style="width: 100px;" type="text" value="1243.06"/>	(45)

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

(46)m=	19.33	16.91	17.45	15.21	14.6	12.59	11.67	13.39	13.55	15.79	17.24	18.72	
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Water storage loss:

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

Temperature factor from Table 2b (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a (52)

Temperature factor from Table 2b (53)

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

Enter (50) or (54) in (55) (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	
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If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	
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Primary circuit loss (annual) from Table 3 (58)

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

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

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	
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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=	184.16	162.65	171.59	154.9	152.58	137.46	133.08	144.56	143.84	160.57	168.43	180.09	(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=	184.16	162.65	171.59	154.9	152.58	137.46	133.08	144.56	143.84	160.57	168.43	180.09	
	Output from water heater (annual) _{1...12}											1893.9	(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=	87.07	77.42	82.9	76.51	76.57	70.71	70.09	73.91	72.84	79.23	81.01	85.72	(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=	103.21	103.21	103.21	103.21	103.21	103.21	103.21	103.21	103.21	103.21	103.21	103.21	(66)

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

(67)m=	34.47	30.62	24.9	18.85	14.09	11.9	12.85	16.71	22.43	28.47	33.23	35.43	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	223.71	226.03	220.18	207.73	192.01	177.23	167.36	165.04	170.89	183.35	199.07	213.84	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	(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=	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	(71)
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Water heating gains (Table 5)

(72)m=	117.03	115.21	111.42	106.27	102.92	98.21	94.21	99.34	101.16	106.49	112.52	115.22	(72)
--------	--------	--------	--------	--------	--------	-------	-------	-------	--------	--------	--------	--------	------

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

(73)m=	456.66	453.31	437.95	414.29	390.47	368.79	355.87	362.54	375.93	399.76	426.26	445.93	(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 ²	Flux Table 6a	g ₋ Table 6b	FF Table 6c	Gains (W)	
Northeast 0.9x	0.77	x 8.65	x 11.28	x 0.63	x 0.7	= 29.83	(75)
Northeast 0.9x	0.77	x 8.65	x 22.97	x 0.63	x 0.7	= 60.72	(75)
Northeast 0.9x	0.77	x 8.65	x 41.38	x 0.63	x 0.7	= 109.4	(75)
Northeast 0.9x	0.77	x 8.65	x 67.96	x 0.63	x 0.7	= 179.67	(75)
Northeast 0.9x	0.77	x 8.65	x 91.35	x 0.63	x 0.7	= 241.51	(75)
Northeast 0.9x	0.77	x 8.65	x 97.38	x 0.63	x 0.7	= 257.47	(75)
Northeast 0.9x	0.77	x 8.65	x 91.1	x 0.63	x 0.7	= 240.86	(75)
Northeast 0.9x	0.77	x 8.65	x 72.63	x 0.63	x 0.7	= 192.02	(75)

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Northeast 0.9x	0.77	x	8.65	x	50.42	x	0.63	x	0.7	=	133.31	(75)
Northeast 0.9x	0.77	x	8.65	x	28.07	x	0.63	x	0.7	=	74.21	(75)
Northeast 0.9x	0.77	x	8.65	x	14.2	x	0.63	x	0.7	=	37.53	(75)
Northeast 0.9x	0.77	x	8.65	x	9.21	x	0.63	x	0.7	=	24.36	(75)

Solar gains in watts, calculated for each month

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

(83)m=	29.83	60.72	109.4	179.67	241.51	257.47	240.86	192.02	133.31	74.21	37.53	24.36	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	486.5	514.03	547.35	593.96	631.98	626.26	596.73	554.55	509.23	473.97	463.8	470.3	(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)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	0.85	0.82	0.75	0.62	0.48	0.33	0.24	0.27	0.44	0.66	0.8	0.86	

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

(87)m=	20.32	20.44	20.64	20.85	20.95	20.99	21	21	20.97	20.84	20.58	20.3	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.36	20.36	20.37	20.38	20.38	20.39	20.39	20.39	20.38	20.38	20.37	20.37	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.84	0.8	0.73	0.6	0.45	0.3	0.21	0.24	0.4	0.63	0.78	0.85	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.46	19.63	19.9	20.19	20.33	20.38	20.39	20.39	20.36	20.19	19.83	19.43	(90)
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fLA = Living area ÷ (4) =

0.45 (91)

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

(92)m=	19.84	19.99	20.23	20.49	20.61	20.66	20.66	20.66	20.64	20.49	20.17	19.82	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.84	19.99	20.23	20.49	20.61	20.66	20.66	20.66	20.64	20.49	20.17	19.82	(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=	0.83	0.79	0.73	0.6	0.46	0.32	0.22	0.25	0.42	0.63	0.77	0.84	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	401.82	407.9	397.84	359.12	289.78	197.99	133.61	139.5	212.32	300.75	358	393.34	(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=	537.1	519.71	471.16	390.4	299.12	199.63	133.93	140.01	217.09	331.93	441.94	532.17	(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=	100.65	75.14	54.54	22.52	6.95	0	0	0	0	23.19	60.44	103.28	(98)
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

446.72 (98)

Space heating requirement in kWh/m²/year

8.76 (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)
<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		1.05	(306)
Space heating		kWh/year	
Annual space heating requirement		446.72	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	469.05	(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		1893.9	
If DHW from community scheme:			
Water heat from Community boilers	(64) x (303a) x (305) x (306) =	1988.6	(310a)
Electricity used for heat distribution	0.01 x [(307a)...(307e) + (310a)...(310e)] =	24.58	(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		177.01	(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) =	177.01	(331)
Energy for lighting (calculated in Appendix L)		243.51	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-518.71	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year
Space heating from CHP	(307a) x		4.24	x 0.01 =	19.89 (340a)
Water heating from CHP	(310a) x		4.24	x 0.01 =	84.32 (342a)
Pumps and fans	(331)		13.19	x 0.01 =	23.35 (349)
Energy for lighting	(332)		13.19	x 0.01 =	32.12 (350)

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Additional standing charges (Table 12)		120	(351)
Energy saving/generation technologies			
Total energy cost	$= (340a)...(342e) + (345)...(354) =$	279.67	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	$[(355) \times (356)] \div [(4) + 45.0] =$	1.22	(357)
SAP rating (section12)		82.94	(358)

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>				94	(367a)
CO2 associated with heat source 1	$[(307b)+(310b)] \times 100 \div (367b) \times$		0.22	=		564.74	(367)
Electrical energy for heat distribution	$[(313) \times$		0.52	=		12.76	(372)
Total CO2 associated with community systems	$(363)...(366) + (368)...(372)$			=		577.49	(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	$(373) + (374) + (375) =$					577.49	(376)
CO2 associated with electricity for pumps and fans within dwelling	$(331) \times$		0.52	=		91.87	(378)
CO2 associated with electricity for lighting	$(332)) \times$		0.52	=		126.38	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1			0.52	x 0.01 =		-269.21	(380)
Total CO2, kg/year	<i>sum of (376)...(382) =</i>					526.53	(383)
Dwelling CO2 Emission Rate	$(383) \div (4) =$					10.32	(384)
EI rating (section 14)						92.65	(385)

13b. Primary Energy – Community heating scheme

	Energy kWh/year		Primary factor			P.Energy kWh/year	
Energy 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>				94	(367a)
Energy associated with heat source 1	$[(307b)+(310b)] \times 100 \div (367b) \times$		1.22	=		3189.72	(367)
Electrical energy for heat distribution	$[(313) \times$			=		75.45	(372)
Total Energy associated with community systems	$(363)...(366) + (368)...(372)$			=		3265.17	(373)
<i>if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)</i>						3265.17	(373)
Energy associated with space heating (secondary)	$(309) \times$		0	=		0	(374)
Energy associated with water from immersion heater or instantaneous heater	$(312) \times$		1.22	=		0	(375)
Total Energy associated with space and water heating	$(373) + (374) + (375) =$					3265.17	(376)
Energy associated with space cooling	$(315) \times$		3.07	=		0	(377)

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Energy associated with electricity for pumps and fans within dwelling	(331)) x	<input type="text" value="3.07"/>	=	<input type="text" value="543.43"/>	(378)
Energy associated with electricity for lighting	(332))) x	<input type="text" value="3.07"/>	=	<input type="text" value="747.56"/>	(379)
Energy saving/generation technologies Item 1		<input type="text" value="3.07"/>	x 0.01 =	<input type="text" value="-1592.44"/>	(380)
Total Primary Energy, kWh/year	sum of (376)...(382) =			<input type="text" value="2963.73"/>	(383)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Zahid Ashraf	Stroma Number:	STRO001082
Software Name:	Stroma FSAP 2012	Software Version:	Version: 1.0.5.9

Property Address: Plot 26

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	51.02	(1a) x	2.5	(2a) =	127.55 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.02	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.55 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							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) =	0.16 (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			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.32 (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

0.4	0.39	0.39	0.35	0.34	0.3	0.3	0.29	0.32	0.34	0.35	0.37
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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
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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)m² 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 ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K
Doors			2	1	2		(26)
Windows			8.651	x1/[1/(1.4)+0.04]	11.47		(27)
Walls Type1	24.16	8.65	15.51	x 0.18	2.79		(29)
Walls Type2	18.88	2	16.88	x 0.18	3.04		(29)
Total area of elements, m ²			43.04				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2
 ** include the areas on both sides of internal walls and partitions

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

19.3

 (33)

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

453.39

 (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

3.76

 (36)

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

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

23.06

 (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
24.45	24.32	24.19	23.58	23.46	22.93	22.93	22.84	23.14	23.46	23.69	23.93

 (38)

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

(39)m=

47.51	47.38	47.25	46.64	46.53	46	46	45.9	46.2	46.53	46.76	47
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Average = Sum(39)_{1...12} /12=

46.64

 (39)

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

(40)m=

0.93	0.93	0.93	0.91	0.91	0.9	0.9	0.9	0.91	0.91	0.92	0.92
------	------	------	------	------	-----	-----	-----	------	------	------	------

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

0.91

 (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 (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 (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=	82.56	79.56	76.56	73.55	70.55	67.55	67.55	70.55	73.55	76.56	79.56	82.56	
Total = Sum(44) _{1...12} =												900.66	(44)

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

(45)m=	122.44	107.08	110.5	96.34	92.44	79.77	73.91	84.82	85.83	100.03	109.19	118.57	
Total = Sum(45) _{1...12} =												1180.91	(45)

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

(46)m=	18.37	16.06	16.57	14.45	13.87	11.96	11.09	12.72	12.87	15	16.38	17.79	
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	--

Water storage loss:

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

Temperature factor from Table 2b (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a (52)

Temperature factor from Table 2b (53)

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

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

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	
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--

Primary circuit loss (annual) from Table 3 (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	
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--

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

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

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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=	169.03	149.17	157.09	141.43	139.03	124.86	120.51	131.41	130.92	146.62	154.28	165.17	(62)
---------------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------------

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

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

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

Output from water heater

(64)m=	169.03	149.17	157.09	141.43	139.03	124.86	120.51	131.41	130.92	146.62	154.28	165.17		
Output from water heater (annual)_{1...12}												(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=	77.99	69.27	74.02	68.11	68.01	62.6	61.85	65.48	64.61	70.54	72.38	76.7	(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=	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	86.01	(66)

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

(67)m=	13.79	12.25	9.96	7.54	5.64	4.76	5.14	6.68	8.97	11.39	13.29	14.17	(67)
---------------	-------	-------	------	------	------	------	------	------	------	-------	-------	-------	-------------

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

(68)m=	149.89	151.44	147.52	139.18	128.65	118.75	112.13	110.58	114.5	122.84	133.37	143.27	(68)
---------------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------------

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

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

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
---------------	---	---	---	---	---	---	---	---	---	---	---	---	-------------

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

(71)m=	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	-68.81	(71)
---------------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------------

Water heating gains (Table 5)

(72)m=	104.82	103.09	99.49	94.59	91.41	86.94	83.14	88.01	89.74	94.81	100.53	103.09	(72)
---------------	--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	--------	--------	-------------

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

(73)m=	320.3	318.58	308.77	293.11	277.5	262.25	252.21	257.07	265.01	280.84	299	312.34	(73)
---------------	-------	--------	--------	--------	-------	--------	--------	--------	--------	--------	-----	--------	-------------

6. Solar gains:

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

Orientation:	Access Factor Table 6d	x	Area m ²	x	Flux Table 6a	x	g _o Table 6b	x	FF Table 6c	=	Gains (W)	
Northeast 0.9x	0.77	x	8.65	x	11.28	x	0.63	x	0.7	=	29.83	(75)
Northeast 0.9x	0.77	x	8.65	x	22.97	x	0.63	x	0.7	=	60.72	(75)
Northeast 0.9x	0.77	x	8.65	x	41.38	x	0.63	x	0.7	=	109.4	(75)
Northeast 0.9x	0.77	x	8.65	x	67.96	x	0.63	x	0.7	=	179.67	(75)
Northeast 0.9x	0.77	x	8.65	x	91.35	x	0.63	x	0.7	=	241.51	(75)
Northeast 0.9x	0.77	x	8.65	x	97.38	x	0.63	x	0.7	=	257.47	(75)
Northeast 0.9x	0.77	x	8.65	x	91.1	x	0.63	x	0.7	=	240.86	(75)
Northeast 0.9x	0.77	x	8.65	x	72.63	x	0.63	x	0.7	=	192.02	(75)

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Northeast 0.9x	0.77	x	8.65	x	50.42	x	0.63	x	0.7	=	133.31	(75)
Northeast 0.9x	0.77	x	8.65	x	28.07	x	0.63	x	0.7	=	74.21	(75)
Northeast 0.9x	0.77	x	8.65	x	14.2	x	0.63	x	0.7	=	37.53	(75)
Northeast 0.9x	0.77	x	8.65	x	9.21	x	0.63	x	0.7	=	24.36	(75)

Solar gains in watts, calculated for each month

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

(83)m=	29.83	60.72	109.4	179.67	241.51	257.47	240.86	192.02	133.31	74.21	37.53	24.36	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	350.13	379.3	418.17	472.78	519.01	519.72	493.07	449.09	398.32	355.05	336.53	336.7	(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)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	1	0.99	0.98	0.92	0.77	0.56	0.41	0.47	0.75	0.95	0.99	1	

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

(87)m=	20.15	20.26	20.47	20.75	20.94	20.99	21	21	20.96	20.72	20.39	20.13	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

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

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

(89)m=	0.99	0.99	0.97	0.9	0.72	0.49	0.33	0.38	0.68	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=	19.01	19.17	19.48	19.87	20.1	20.16	20.17	20.17	20.13	19.84	19.37	18.98	(90)
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fLA = Living area ÷ (4) =

0.45

 (91)

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

(92)m=	19.52	19.66	19.93	20.27	20.48	20.54	20.54	20.54	20.51	20.24	19.83	19.5	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.52	19.66	19.93	20.27	20.48	20.54	20.54	20.54	20.51	20.24	19.83	19.5	(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	0.9	0.74	0.52	0.37	0.42	0.71	0.94	0.99	0.99	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	347.74	374.78	405.8	426.8	383.55	270.55	181.08	189.57	281.91	332.92	331.81	334.84	(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=	723.16	699.36	634.34	530.36	408.39	273.07	181.33	190.13	296	448.43	595.3	719.09	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-----	--------	-------	--------	------

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

(98)m=	279.31	218.12	170.03	74.57	18.48	0	0	0	0	85.94	189.71	285.88	
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

1322.03

 (98)

Space heating requirement in kWh/m²/year

25.91

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

279.31	218.12	170.03	74.57	18.48	0	0	0	0	85.94	189.71	285.88
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------

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

298.73	233.28	181.85	79.75	19.76	0	0	0	0	91.91	202.9	305.75
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$Total (kWh/year) = Sum(211)_{1..5,10..12} =$ 1413.94 (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)

169.03	149.17	157.09	141.43	139.03	124.86	120.51	131.41	130.92	146.62	154.28	165.17
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Efficiency of water heater 79.8 (216)

$(217)_m =$

86.15	85.83	85.03	83.2	80.92	79.8	79.8	79.8	79.8	83.45	85.37	86.26
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(217)

Fuel for water heating, kWh/month

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

$(219)_m =$

196.22	173.8	184.76	169.99	171.81	156.46	151.01	164.68	164.06	175.71	180.73	191.47
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

$Total = Sum(219a)_{1..12} =$ 2080.71 (219)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1	1413.94	
Water heating fuel used	2080.71	

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 243.51 (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)	$(211) \times$	=	0.216	=	305.41 (261)
Space heating (secondary)	$(215) \times$	=	0.519	=	0 (263)
Water heating	$(219) \times$	=	0.216	=	449.43 (264)
Space and water heating	$(261) + (262) + (263) + (264) =$				754.84 (265)

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Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	126.38	(268)
Total CO2, kg/year		sum of (265)...(271) =		920.15	(272)
TER =				18.03	(273)