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: 63.82m²

Site Reference : Hermitage Lane **Plot Reference:** Plot 45

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)	20 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	12.97 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	54.8 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	43.6 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	0.10 (max. 0.20)	0.10 (max. 0.35)	**OK**
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):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: South West	1.7m²
Windows facing: North West	6.1m²
Ventilation rate:	4.00

10 Key features

Air permeablility	3.0 m³/m²h
Roofs U-value	0.1 W/m²K
External Walls U-value	0.13 W/m²K
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 45

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	63.82	(1a) x	2.5	(2a) =	159.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.82	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	159.56	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

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

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

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

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

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

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

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

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

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

(24d)m=	0	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 (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.4	=	2.8			(26)
Windows Type 1			1.696	x1/[1/(1.4)+ 0.04]		=	2.25			(27)
Windows Type 2			6.097	x1/[1/(1.4)+ 0.04]		=	8.08			(27)
Walls Type1	20.38	7.79	12.58	x	0.15	=	1.89			(29)
Walls Type2	28.8	2	26.8	x	0.14	=	3.79			(29)
Walls Type3	18.13	0	18.13	x	0.13	=	2.4			(29)
Roof	63.82	0	63.82	x	0.1	=	6.38			(30)
Total area of elements, m²			131.13							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.59 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1379.58 (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 13.69 (36)

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

Total fabric heat loss (33) + (36) = 41.28 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	13.32	13.17	13.01	12.25	12.1	11.33	11.33	11.18	11.64	12.1	12.4	12.71	(38)

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

(39)m=	54.59	54.44	54.29	53.52	53.37	52.61	52.61	52.45	52.91	53.37	53.68	53.98	

Average = $Sum(39)_{1…12}$ /12= 53.49 (39)

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

(40)m=	0.86	0.85	0.85	0.84	0.84	0.82	0.82	0.82	0.83	0.84	0.84	0.85

Average = Sum(40)$_{1…12}$ /12= 0.84 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.09 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 88.19 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	97	93.48	89.95	86.42	82.89	79.37	79.37	82.89	86.42	89.95	93.48	97

Total = Sum(44)$_{1…12}$ = 1058.22 (44)

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

(45)m=	143.85	125.82	129.83	113.19	108.61	93.72	86.85	99.66	100.85	117.53	128.29	139.31

Total = Sum(45)$_{1…12}$ = 1387.5 (45)

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

(46)m=	21.58	18.87	19.47	16.98	16.29	14.06	13.03	14.95	15.13	17.63	19.24	20.9	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

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

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

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

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

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

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

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

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

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

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

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

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

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

(62)m=	199.13	175.74	185.11	166.68	163.88	147.21	142.12	154.93	154.34	172.8	181.78	194.59	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	199.13	175.74	185.11	166.68	163.88	147.21	142.12	154.93	154.34	172.8	181.78	194.59	

Output from water heater (annual)1…12 2038.34 (64)

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

(65)m=	92.05	81.78	87.39	80.43	80.33	73.96	73.1	77.36	76.33	83.3	85.45	90.54	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	(66)

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

(67)m=	17.99	15.98	12.99	9.84	7.35	6.21	6.71	8.72	11.7	14.86	17.34	18.49	(67)

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

(68)m=	182.48	184.37	179.6	169.44	156.62	144.56	136.51	134.62	139.39	149.55	162.37	174.42	(68)

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

(69)m=	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	(71)

Water heating gains (Table 5)

(72)m=	123.73	121.69	117.46	111.71	107.98	102.72	98.25	103.97	106.01	111.96	118.68	121.7	(72)

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

(73)m=	378.5	376.35	364.36	345.3	326.26	307.8	295.78	301.62	311.41	330.68	352.71	368.92	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a	g_ Table 6b		FF Table 6c		Gains (W)	
Southwest 0.9x	0.77	x	1.7	x	36.79	0.63	x	0.7	=	19.07	(79)
Southwest 0.9x	0.77	x	1.7	x	62.67	0.63	x	0.7	=	32.48	(79)
Southwest 0.9x	0.77	x	1.7	x	85.75	0.63	x	0.7	=	44.45	(79)
Southwest 0.9x	0.77	x	1.7	x	106.25	0.63	x	0.7	=	55.07	(79)
Southwest 0.9x	0.77	x	1.7	x	119.01	0.63	x	0.7	=	61.69	(79)

Southwest	0.9x	0.77	x	1.7	x	118.15		0.63	x	0.7	=	61.24	(79)
Southwest	0.9x	0.77	x	1.7	x	113.91		0.63	x	0.7	=	59.04	(79)
Southwest	0.9x	0.77	x	1.7	x	104.39		0.63	x	0.7	=	54.11	(79)
Southwest	0.9x	0.77	x	1.7	x	92.85		0.63	x	0.7	=	48.13	(79)
Southwest	0.9x	0.77	x	1.7	x	69.27		0.63	x	0.7	=	35.9	(79)
Southwest	0.9x	0.77	x	1.7	x	44.07		0.63	x	0.7	=	22.84	(79)
Southwest	0.9x	0.77	x	1.7	x	31.49		0.63	x	0.7	=	16.32	(79)
Northwest	0.9x	0.77	x	6.1	x	11.28	x	0.63	x	0.7	=	21.02	(81)
Northwest	0.9x	0.77	x	6.1	x	22.97	x	0.63	x	0.7	=	42.79	(81)
Northwest	0.9x	0.77	x	6.1	x	41.38	x	0.63	x	0.7	=	77.1	(81)
Northwest	0.9x	0.77	x	6.1	x	67.96	x	0.63	x	0.7	=	126.62	(81)
Northwest	0.9x	0.77	x	6.1	x	91.35	x	0.63	x	0.7	=	170.21	(81)
Northwest	0.9x	0.77	x	6.1	x	97.38	x	0.63	x	0.7	=	181.46	(81)
Northwest	0.9x	0.77	x	6.1	x	91.1	x	0.63	x	0.7	=	169.75	(81)
Northwest	0.9x	0.77	x	6.1	x	72.63	x	0.63	x	0.7	=	135.33	(81)
Northwest	0.9x	0.77	x	6.1	x	50.42	x	0.63	x	0.7	=	93.95	(81)
Northwest	0.9x	0.77	x	6.1	x	28.07	x	0.63	x	0.7	=	52.3	(81)
Northwest	0.9x	0.77	x	6.1	x	14.2	x	0.63	x	0.7	=	26.45	(81)
Northwest	0.9x	0.77	x	6.1	x	9.21	x	0.63	x	0.7	=	17.17	(81)

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

(83)m=	40.09	75.28	121.55	181.7	231.89	242.7	228.79	189.43	142.08	88.2	49.3	33.49	(83)

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

(84)m=	418.6	451.63	485.91	526.99	558.15	550.5	524.57	491.06	453.49	418.88	402	402.41	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.95	0.94	0.9	0.83	0.72	0.56	0.42	0.47	0.68	0.86	0.93	0.96	(86)

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

(87)m=	19.4	19.59	19.91	20.35	20.7	20.9	20.97	20.96	20.81	20.38	19.83	19.37	(87)

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

(88)m=	20.21	20.21	20.21	20.22	20.22	20.23	20.23	20.23	20.23	20.22	20.22	20.21	(88)

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

(89)m=	0.95	0.93	0.89	0.81	0.68	0.5	0.36	0.4	0.62	0.83	0.92	0.95	(89)

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

(90)m=	18.05	18.32	18.79	19.4	19.88	20.14	20.21	20.2	20.04	19.47	18.69	18.01	(90)

fLA = Living area ÷ (4) = 0.51 (91)

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

(92)m=	18.73	18.96	19.36	19.88	20.29	20.53	20.59	20.59	20.43	19.93	19.27	18.69	(92)

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

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(93)m=	18.73	18.96	19.36	19.88	20.29	20.53	20.59	20.59	20.43	19.93	19.27	18.69	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.93	0.91	0.88	0.8	0.68	0.52	0.39	0.43	0.64	0.82	0.91	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	390.04	412.53	426	422.72	381.28	288.35	203.55	210.4	289.49	345.16	364.43	377.43	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	787.89	765.31	698.01	587.71	458.47	311.79	210.15	219.55	334.97	497.96	653.04	782.43	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	296.01	237.07	202.38	118.79	57.43	0	0	0	0	113.69	207.8	301.32	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1534.48	(98)
Space heating requirement in kWh/m²/year	24.04	(99)

9b. Energy requirements – Community heating scheme

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

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

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

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1534.48	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1611.2	(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		2038.34	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2140.25	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	37.51	(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		221.43	(330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	221.43	(331)
Energy for lighting (calculated in Appendix L)		317.66	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-642.21	(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	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	862.04	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	19.47	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	881.51	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				881.51	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	114.92	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	164.87	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1		0.52		x 0.01 =	-333.31	(380)
Total CO2, kg/year	sum of (376)…(382) =				827.99	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				12.97	(384)
EI rating (section 14)					89.8	(385)

SAP 2012 Overheating Assessment

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

Property Details: Plot 45

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	No
Number of storeys:	1
Front of dwelling faces:	North East
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:	210.62	**(P1)**
Transmission heat loss coefficient:	41.3	
Summer heat loss coefficient:	251.89	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
South West (SW)	0	1
North West (NW)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
South West (SW)	1	0.9	1	0.9	**(P8)**
North West (NW)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
South West (SW)	0.9 x	1.7	119.92	0.63	0.7	0.9	72.65	
North West (NW)	0.9 x	6.1	98.85	0.63	0.7	0.9	215.28	
						Total	287.93	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	425.36	410.13	418.06	
Total summer gains	734.03	698.06	661.95	**(P5)**
Summer gain/loss ratio	2.91	2.77	2.63	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	1.3	1.3	1.3	
Threshold temperature	20.21	21.97	21.73	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Slight**	**Slight**	

Assessment of likelihood of high internal temperature: Slight

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 45

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	63.82	(1a) x	2.5	(2a) =	159.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.82	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	159.56	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

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

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

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.28	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.21	(21)

Infiltration rate modified for monthly wind speed

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

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

0.27	0.27	0.26	0.23	0.23	0.2	0.2	0.2	0.21	0.23	0.24	0.25

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

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

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

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

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

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

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

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

(24d)m=	0.54	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.53	0.53	(24d)

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

(25)m=	0.54	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.53	0.53	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.4	=	2.8			(26)
Windows Type 1			1.696	x1/[1/(1.4)+ 0.04]		=	2.25			(27)
Windows Type 2			6.097	x1/[1/(1.4)+ 0.04]		=	8.08			(27)
Walls Type1	20.38	7.79	12.58	x	0.15	=	1.89			(29)
Walls Type2	28.8	2	26.8	x	0.14	=	3.79			(29)
Walls Type3	18.13	0	18.13	x	0.13	=	2.4			(29)
Roof	63.82	0	63.82	x	0.1	=	6.38			(30)
Total area of elements, m²			131.13							(31)

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

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

Fabric heat loss, W/K = S (A x U) — (26)…(30) + (32) = 27.59 (33)

Heat capacity Cm = S(A x k) — ((28)…(30) + (32) + (32a)…(32e) = 1379.58 (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 — 13.69 (36)

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

Total fabric heat loss — (33) + (36) = 41.28 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.28	28.2	28.13	27.78	27.71	27.41	27.41	27.35	27.53	27.71	27.84	27.98	(38)

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

(39)m=	69.55	69.48	69.4	69.05	68.99	68.68	68.68	68.63	68.8	68.99	69.12	69.26	

Average = Sum(39)$_{1…12}$ /12= 69.05 (39)

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

(40)m=	1.09	1.09	1.09	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.09	

Average = Sum(40)$_{1…12}$ /12= 1.08 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.09 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 88.19 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	97	93.48	89.95	86.42	82.89	79.37	79.37	82.89	86.42	89.95	93.48	97	

Total = Sum(44)$_{1…12}$ = 1058.22 (44)

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

(45)m=	143.85	125.82	129.83	113.19	108.61	93.72	86.85	99.66	100.85	117.53	128.29	139.31	

Total = Sum(45)$_{1…12}$ = 1387.5 (45)

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

(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 0 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

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

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

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

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

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

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

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

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

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

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

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

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

(62)m=	122.28	106.94	110.36	96.21	92.32	79.66	73.82	84.71	85.72	99.9	109.05	118.42	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	122.28	106.94	110.36	96.21	92.32	79.66	73.82	84.71	85.72	99.9	109.05	118.42	

Output from water heater (annual)$_{1...12}$ 1179.37 (64)

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

(65)m=	30.57	26.74	27.59	24.05	23.08	19.92	18.45	21.18	21.43	24.97	27.26	29.6	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	(66)

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

(67)m=	17.99	15.98	12.99	9.84	7.35	6.21	6.71	8.72	11.7	14.86	17.34	18.49	(67)

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

(68)m=	182.48	184.37	179.6	169.44	156.62	144.56	136.51	134.62	139.39	149.55	162.37	174.42	(68)

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

(69)m=	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	(71)

Water heating gains (Table 5)

(72)m=	41.09	39.79	37.08	33.41	31.02	27.66	24.8	28.46	29.76	33.57	37.86	39.79	(72)

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

(73)m=	295.86	294.44	283.98	266.99	249.3	232.74	222.34	226.11	235.17	252.29	271.89	287.01	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a	g_ Table 6b		FF Table 6c		Gains (W)	
Southwest 0.9x	0.77	x	1.7	x	36.79	0.63	x	0.7	=	19.07	(79)
Southwest 0.9x	0.77	x	1.7	x	62.67	0.63	x	0.7	=	32.48	(79)
Southwest 0.9x	0.77	x	1.7	x	85.75	0.63	x	0.7	=	44.45	(79)
Southwest 0.9x	0.77	x	1.7	x	106.25	0.63	x	0.7	=	55.07	(79)
Southwest 0.9x	0.77	x	1.7	x	119.01	0.63	x	0.7	=	61.69	(79)

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Southwest	0.9x	0.77	x	1.7	x	118.15		0.63	x	0.7	=	61.24 (79)
Southwest	0.9x	0.77	x	1.7	x	113.91		0.63	x	0.7	=	59.04 (79)
Southwest	0.9x	0.77	x	1.7	x	104.39		0.63	x	0.7	=	54.11 (79)
Southwest	0.9x	0.77	x	1.7	x	92.85		0.63	x	0.7	=	48.13 (79)
Southwest	0.9x	0.77	x	1.7	x	69.27		0.63	x	0.7	=	35.9 (79)
Southwest	0.9x	0.77	x	1.7	x	44.07		0.63	x	0.7	=	22.84 (79)
Southwest	0.9x	0.77	x	1.7	x	31.49		0.63	x	0.7	=	16.32 (79)
Northwest	0.9x	0.77	x	6.1	x	11.28	x	0.63	x	0.7	=	21.02 (81)
Northwest	0.9x	0.77	x	6.1	x	22.97	x	0.63	x	0.7	=	42.79 (81)
Northwest	0.9x	0.77	x	6.1	x	41.38	x	0.63	x	0.7	=	77.1 (81)
Northwest	0.9x	0.77	x	6.1	x	67.96	x	0.63	x	0.7	=	126.62 (81)
Northwest	0.9x	0.77	x	6.1	x	91.35	x	0.63	x	0.7	=	170.21 (81)
Northwest	0.9x	0.77	x	6.1	x	97.38	x	0.63	x	0.7	=	181.46 (81)
Northwest	0.9x	0.77	x	6.1	x	91.1	x	0.63	x	0.7	=	169.75 (81)
Northwest	0.9x	0.77	x	6.1	x	72.63	x	0.63	x	0.7	=	135.33 (81)
Northwest	0.9x	0.77	x	6.1	x	50.42	x	0.63	x	0.7	=	93.95 (81)
Northwest	0.9x	0.77	x	6.1	x	28.07	x	0.63	x	0.7	=	52.3 (81)
Northwest	0.9x	0.77	x	6.1	x	14.2	x	0.63	x	0.7	=	26.45 (81)
Northwest	0.9x	0.77	x	6.1	x	9.21	x	0.63	x	0.7	=	17.17 (81)

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

(83)m=	40.09	75.28	121.55	181.7	231.89	242.7	228.79	189.43	142.08	88.2	49.3	33.49	(83)

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

(84)m=	335.96	369.72	405.53	448.69	481.19	475.44	451.13	415.55	377.25	340.49	321.18	320.5	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.97	0.97	0.95	0.9	0.83	0.7	0.57	0.62	0.81	0.93	0.97	0.98	(86)

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

(87)m=	18.62	18.82	19.22	19.77	20.3	20.7	20.88	20.84	20.51	19.85	19.14	18.57	(87)

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

(88)m=	20.01	20.01	20.01	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.01	20.01	(88)

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

(89)m=	0.97	0.96	0.94	0.89	0.79	0.64	0.47	0.53	0.76	0.91	0.96	0.97	(89)

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

(90)m=	17.82	18.02	18.42	18.96	19.46	19.82	19.96	19.94	19.67	19.04	18.34	17.77	(90)

fLA = Living area ÷ (4) = 0.51 (91)

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

(92)m=	18.22	18.43	18.82	19.37	19.89	20.26	20.42	20.39	20.1	19.45	18.74	18.17	(92)

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

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(93)m=	18.22	18.43	18.82	19.37	19.89	20.26	20.42	20.39	20.1	19.45	18.74	18.17	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.96	0.95	0.93	0.87	0.79	0.65	0.52	0.57	0.76	0.9	0.95	0.97	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	323.1	351.09	375.24	392.39	378.3	311.1	233.52	235.9	287.78	305.6	304.62	309.55	(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=	968.23	939.79	855.19	722.78	564.7	388.96	262.57	274.05	412.56	610.41	804.65	967.7	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	479.97	395.61	357.08	237.88	138.68	0	0	0	0	226.78	360.02	489.66	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2685.69 (98)

Space heating requirement in kWh/m²/year 42.08 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	645.63	508.26	521.57	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.72	0.79	0.76	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	467.79	401.97	396	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	633.98	604.1	563.96	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	119.66	150.38	124.97	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 395.01 (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(104)$_{6...8}$ = 0 (106)

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

(107)m=	0	0	0	0	0	29.91	37.6	31.24	0	0	0	0

Total = Sum(107)$_{6...8}$ = 98.75 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.55 (108)

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

Fabric Energy Efficiency (99) + (108) = 43.63 (109)

SAP Input

Property Details: Plot 45

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	63.823 m²	2.5 m
Living area:	32.253 m² (fraction 0.505)	
Front of dwelling faces:	North East	

Opening types:

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

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
NE	mm	0	0	1.4	2	1
SW	16mm or more	0.7	0.63	1.4	1.696	1
NW	16mm or more	0.7	0.63	1.4	6.097	1

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

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
External Wall	20.377	7.79	12.58	0.15	0	False	N/A
Corridor Wall	28.802	2	26.8	0.15	0.4	False	N/A
Stairwell Wall	18.126	0	18.13	0.15	0.9	False	N/A
Flat Roof	63.823	0	63.82	0.1	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.1044

Length	**Psi-value**		
4.56	0.289	E2	Other lintels (including other steel lintels)

SAP Input

	12.469	0.047	E4	Jamb
	25.397	0.061	E7	Party floor between dwellings (in blocks of flats)
	7.95	0.074	E16	Corner (normal)
	10.6	-0.077	E17	Corner (inverted internal area greater than external area)
	5.3	0.096	E25	Staggered party wall between dwellings
[Approved]	5.3	0.06	E18	Party wall between dwellings
[Approved]	0.9	0.04	E3	Sill
	17.708	0.08	E14	Flat roof
	7.689	0.56	E15	Flat roof with parapet
	16.145	0	P3	Intermediate floor between dwellings (in blocks of flats)
	16.145	0.24	P4	Roof (insulation at ceiling level)

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

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:	Photovoltaic 1 Installed Peak power: 0.78 Tilt of collector: 30°

SAP Input

	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 45

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.82	(1a)	x	2.5	(2a)	=	159.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.82	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	159.56	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

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

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

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
(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

0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

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

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

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

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

(25)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1	=	2			(26)
Windows Type 1			1.696	x1/[1/(1.4)+ 0.04]		=	2.25			(27)
Windows Type 2			6.097	x1/[1/(1.4)+ 0.04]		=	8.08			(27)
Walls Type1	20.38	7.79	12.58	x	0.18	=	2.27			(29)
Walls Type2	28.8	2	26.8	x	0.18	=	4.82			(29)
Walls Type3	18.13	0	18.13	x	0.18	=	3.26			(29)
Roof	63.82	0	63.82	x	0.13	=	8.3			(30)
Total area of elements, m²			131.13							(31)

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.98 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1379.58 (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 10.73 (36)

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

Total fabric heat loss (33) + (36) = 41.71 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.95	29.81	29.67	29.02	28.9	28.34	28.34	28.23	28.55	28.9	29.15	29.4	(38)

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

(39)m=	71.66	71.52	71.38	70.73	70.61	70.05	70.05	69.95	70.27	70.61	70.86	71.12	

Average = Sum(39)$_{1…12}$ /12= 70.73 (39)

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

(40)m=	1.12	1.12	1.12	1.11	1.11	1.1	1.1	1.1	1.1	1.11	1.11	1.11

Average = Sum(40)$_{1…12}$ /12= 1.11 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.09 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.78 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	92.15	88.8	85.45	82.1	78.75	75.4	75.4	78.75	82.1	85.45	88.8	92.15	
									Total = Sum(44)$_{1…12}$ =			1005.31	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	136.66	119.52	123.34	107.53	103.18	89.03	82.5	94.67	95.8	111.65	121.88	132.35	
									Total = Sum(45)$_{1…12}$ =			1318.12	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(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 150 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

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

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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

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

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

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

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

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

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

(62)m=	116.16	101.6	104.84	91.4	87.7	75.68	70.13	80.47	81.43	94.9	103.59	112.5	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	116.16	101.6	104.84	91.4	87.7	75.68	70.13	80.47	81.43	94.9	103.59	112.5	

Output from water heater (annual)$_{1...12}$ 1120.4 (64)

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

(65)m=	29.04	25.4	26.21	22.85	21.93	18.92	17.53	20.12	20.36	23.73	25.9	28.12	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.99	15.98	12.99	9.84	7.35	6.21	6.71	8.72	11.7	14.86	17.34	18.49	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	182.48	184.37	179.6	169.44	156.62	144.56	136.51	134.62	139.39	149.55	162.37	174.42	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	(71)
Water heating gains (Table 5)													
(72)m=	39.03	37.8	35.23	31.74	29.47	26.28	23.56	27.04	28.28	31.89	35.97	37.8	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	293.81	292.45	282.13	265.32	247.75	231.36	221.1	224.69	233.68	250.61	270	285.02	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a	g_ Table 6b		FF Table 6c		Gains (W)	
Southwest 0.9x	0.77	x	1.7	x	36.79	0.63	x	0.7	=	19.07	(79)
Southwest 0.9x	0.77	x	1.7	x	62.67	0.63	x	0.7	=	32.48	(79)
Southwest 0.9x	0.77	x	1.7	x	85.75	0.63	x	0.7	=	44.45	(79)
Southwest 0.9x	0.77	x	1.7	x	106.25	0.63	x	0.7	=	55.07	(79)
Southwest 0.9x	0.77	x	1.7	x	119.01	0.63	x	0.7	=	61.69	(79)

Southwest	0.9x	0.77	x	1.7	x	118.15		0.63	x	0.7	=	61.24	(79)
Southwest	0.9x	0.77	x	1.7	x	113.91		0.63	x	0.7	=	59.04	(79)
Southwest	0.9x	0.77	x	1.7	x	104.39		0.63	x	0.7	=	54.11	(79)
Southwest	0.9x	0.77	x	1.7	x	92.85		0.63	x	0.7	=	48.13	(79)
Southwest	0.9x	0.77	x	1.7	x	69.27		0.63	x	0.7	=	35.9	(79)
Southwest	0.9x	0.77	x	1.7	x	44.07		0.63	x	0.7	=	22.84	(79)
Southwest	0.9x	0.77	x	1.7	x	31.49		0.63	x	0.7	=	16.32	(79)
Northwest	0.9x	0.77	x	6.1	x	11.28	x	0.63	x	0.7	=	21.02	(81)
Northwest	0.9x	0.77	x	6.1	x	22.97	x	0.63	x	0.7	=	42.79	(81)
Northwest	0.9x	0.77	x	6.1	x	41.38	x	0.63	x	0.7	=	77.1	(81)
Northwest	0.9x	0.77	x	6.1	x	67.96	x	0.63	x	0.7	=	126.62	(81)
Northwest	0.9x	0.77	x	6.1	x	91.35	x	0.63	x	0.7	=	170.21	(81)
Northwest	0.9x	0.77	x	6.1	x	97.38	x	0.63	x	0.7	=	181.46	(81)
Northwest	0.9x	0.77	x	6.1	x	91.1	x	0.63	x	0.7	=	169.75	(81)
Northwest	0.9x	0.77	x	6.1	x	72.63	x	0.63	x	0.7	=	135.33	(81)
Northwest	0.9x	0.77	x	6.1	x	50.42	x	0.63	x	0.7	=	93.95	(81)
Northwest	0.9x	0.77	x	6.1	x	28.07	x	0.63	x	0.7	=	52.3	(81)
Northwest	0.9x	0.77	x	6.1	x	14.2	x	0.63	x	0.7	=	26.45	(81)
Northwest	0.9x	0.77	x	6.1	x	9.21	x	0.63	x	0.7	=	17.17	(81)

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

(83)m=	40.09	75.28	121.55	181.7	231.89	242.7	228.79	189.43	142.08	88.2	49.3	33.49	(83)

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

(84)m=	333.9	367.73	403.68	447.02	479.64	474.06	449.89	414.12	375.76	338.81	319.29	318.51	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.98	0.94	0.81	0.65	0.72	0.92	0.99	1	1	(86)

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

(87)m=	19.72	19.84	20.06	20.38	20.69	20.91	20.98	20.96	20.8	20.41	20.01	19.7	(87)

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

(88)m=	19.98	19.98	19.99	19.99	20	20	20	20	20	20	19.99	19.99	(88)

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

(89)m=	1	1	0.99	0.98	0.91	0.73	0.52	0.59	0.88	0.98	1	1	(89)

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

(90)m=	18.81	18.93	19.15	19.48	19.77	19.96	20	19.99	19.87	19.51	19.11	18.8	(90)

fLA = Living area ÷ (4) = 0.51 (91)

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

(92)m=	19.27	19.39	19.61	19.93	20.24	20.44	20.49	20.48	20.34	19.96	19.57	19.25	(92)

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

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(93)m=	19.27	19.39	19.61	19.93	20.24	20.44	20.49	20.48	20.34	19.96	19.57	19.25	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.92	0.77	0.59	0.66	0.9	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	333.32	366.56	400.62	436.01	440.07	365.68	264.43	271.5	336.7	333.56	318.23	318.08	(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=	1073	1036.32	936.07	780.55	602.94	408.9	272.67	285.62	438.46	661.1	883.34	1070.6	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	550.32	450.08	398.38	248.07	121.17	0	0	0	0	243.69	406.88	559.87	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2978.46 (98)

Space heating requirement in kWh/m²/year 46.67 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	658.47	518.37	531.59	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.9	0.86	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	541.2	464.11	458.29	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	632.6	602.86	562.54	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	65.81	103.23	77.56	0	0	0	0	

Total = $Sum(104)_{6...8}$ = 246.6 (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 = $Sum(104)_{6...8}$ = 0 (106)

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

(107)m=	0	0	0	0	0	16.45	25.81	19.39	0	0	0	0

Total = $Sum(107)_{6...8}$ = 61.65 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.97 (108)

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

Fabric Energy Efficiency (99) + (108) = 47.63 (109)

Target Fabric Energy Efficiency (TFEE) 54.78 (109)

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 45

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.82	(1a)	x	2.5	(2a)	=	159.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.82	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			159.56	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

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

Infiltration rate modified for monthly wind speed

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

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	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 (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.4	=	2.8			(26)
Windows Type 1			1.696	x1/[1/(1.4)+ 0.04]		=	2.25			(27)
Windows Type 2			6.097	x1/[1/(1.4)+ 0.04]		=	8.08			(27)
Walls Type1	20.38	7.79	12.58	x	0.15	=	1.89			(29)
Walls Type2	28.8	2	26.8	x	0.14	=	3.79			(29)
Walls Type3	18.13	0	18.13	x	0.13	=	2.4			(29)
Roof	63.82	0	63.82	x	0.1	=	6.38			(30)
Total area of elements, m²			131.13							(31)

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.59 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1379.58 (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 13.69 (36)

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

Total fabric heat loss (33) + (36) = 41.28 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	13.32	13.17	13.01	12.25	12.1	11.33	11.33	11.18	11.64	12.1	12.4	12.71	(38)

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

(39)m=	54.59	54.44	54.29	53.52	53.37	52.61	52.61	52.45	52.91	53.37	53.68	53.98	

Average = Sum(39)$_{1…12}$ /12= 53.49 (39)

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

(40)m=	0.86	0.85	0.85	0.84	0.84	0.82	0.82	0.82	0.83	0.84	0.84	0.85

Average = Sum(40)$_{1…12}$ /12= 0.84 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.09 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 88.19 (43)

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

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

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

(44)m=	97	93.48	89.95	86.42	82.89	79.37	79.37	82.89	86.42	89.95	93.48	97

Total = Sum(44)$_{1…12}$ = 1058.22 (44)

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

(45)m=	143.85	125.82	129.83	113.19	108.61	93.72	86.85	99.66	100.85	117.53	128.29	139.31

Total = Sum(45)$_{1…12}$ = 1387.5 (45)

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

(46)m=	21.58	18.87	19.47	16.98	16.29	14.06	13.03	14.95	15.13	17.63	19.24	20.9	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

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

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

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

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

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

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

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

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

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

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

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

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

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

(62)m=	199.13	175.74	185.11	166.68	163.88	147.21	142.12	154.93	154.34	172.8	181.78	194.59	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	199.13	175.74	185.11	166.68	163.88	147.21	142.12	154.93	154.34	172.8	181.78	194.59

Output from water heater (annual)$_{1...12}$ 2038.34 (64)

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

(65)m=	92.05	81.78	87.39	80.43	80.33	73.96	73.1	77.36	76.33	83.3	85.45	90.54	(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=	125.24	125.24	125.24	125.24	125.24	125.24	125.24	125.24	125.24	125.24	125.24	125.24	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	44.97	39.94	32.48	24.59	18.38	15.52	16.77	21.8	29.26	37.15	43.36	46.22	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	272.35	275.18	268.06	252.89	233.76	215.77	203.75	200.92	208.05	223.21	242.35	260.33	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	49.61	49.61	49.61	49.61	49.61	49.61	49.61	49.61	49.61	49.61	49.61	49.61	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	(71)
Water heating gains (Table 5)													
(72)m=	123.73	121.69	117.46	111.71	107.98	102.72	98.25	103.97	106.01	111.96	118.68	121.7	(72)
Total internal gains =				(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m									
(73)m=	532.41	528.17	509.36	480.55	451.47	425.36	410.13	418.06	434.67	463.68	495.74	519.61	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a	g_ Table 6b		FF Table 6c		Gains (W)	
Southwest 0.9x	0.77	x	1.7	x	36.79	0.63	x	0.7	=	19.07	(79)
Southwest 0.9x	0.77	x	1.7	x	62.67	0.63	x	0.7	=	32.48	(79)
Southwest 0.9x	0.77	x	1.7	x	85.75	0.63	x	0.7	=	44.45	(79)
Southwest 0.9x	0.77	x	1.7	x	106.25	0.63	x	0.7	=	55.07	(79)
Southwest 0.9x	0.77	x	1.7	x	119.01	0.63	x	0.7	=	61.69	(79)

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Southwest 0.9x	0.77	x	1.7	x	118.15		0.63	x	0.7	=	61.24	(79)
Southwest 0.9x	0.77	x	1.7	x	113.91		0.63	x	0.7	=	59.04	(79)
Southwest 0.9x	0.77	x	1.7	x	104.39		0.63	x	0.7	=	54.11	(79)
Southwest 0.9x	0.77	x	1.7	x	92.85		0.63	x	0.7	=	48.13	(79)
Southwest 0.9x	0.77	x	1.7	x	69.27		0.63	x	0.7	=	35.9	(79)
Southwest 0.9x	0.77	x	1.7	x	44.07		0.63	x	0.7	=	22.84	(79)
Southwest 0.9x	0.77	x	1.7	x	31.49		0.63	x	0.7	=	16.32	(79)
Northwest 0.9x	0.77	x	6.1	x	11.28	x	0.63	x	0.7	=	21.02	(81)
Northwest 0.9x	0.77	x	6.1	x	22.97	x	0.63	x	0.7	=	42.79	(81)
Northwest 0.9x	0.77	x	6.1	x	41.38	x	0.63	x	0.7	=	77.1	(81)
Northwest 0.9x	0.77	x	6.1	x	67.96	x	0.63	x	0.7	=	126.62	(81)
Northwest 0.9x	0.77	x	6.1	x	91.35	x	0.63	x	0.7	=	170.21	(81)
Northwest 0.9x	0.77	x	6.1	x	97.38	x	0.63	x	0.7	=	181.46	(81)
Northwest 0.9x	0.77	x	6.1	x	91.1	x	0.63	x	0.7	=	169.75	(81)
Northwest 0.9x	0.77	x	6.1	x	72.63	x	0.63	x	0.7	=	135.33	(81)
Northwest 0.9x	0.77	x	6.1	x	50.42	x	0.63	x	0.7	=	93.95	(81)
Northwest 0.9x	0.77	x	6.1	x	28.07	x	0.63	x	0.7	=	52.3	(81)
Northwest 0.9x	0.77	x	6.1	x	14.2	x	0.63	x	0.7	=	26.45	(81)
Northwest 0.9x	0.77	x	6.1	x	9.21	x	0.63	x	0.7	=	17.17	(81)

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

(83)m=	40.09	75.28	121.55	181.7	231.89	242.7	228.79	189.43	142.08	88.2	49.3	33.49	(83)

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

(84)m=	572.5	603.45	630.91	662.25	683.37	668.06	638.92	607.49	576.75	551.88	545.04	553.1	(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=	0.9	0.88	0.84	0.75	0.63	0.48	0.35	0.39	0.57	0.76	0.87	0.91	(86)

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

(87)m=	19.76	19.92	20.19	20.53	20.79	20.94	20.98	20.98	20.89	20.58	20.14	19.73	(87)

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

(88)m=	20.21	20.21	20.21	20.22	20.22	20.23	20.23	20.23	20.23	20.22	20.22	20.21	(88)

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

(89)m=	0.89	0.87	0.82	0.73	0.59	0.43	0.29	0.32	0.52	0.73	0.85	0.9	(89)

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

(90)m=	18.57	18.79	19.17	19.65	19.99	20.18	20.22	20.22	20.12	19.72	19.11	18.53	(90)

fLA = Living area ÷ (4) = 0.51 (91)

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

(92)m=	19.17	19.36	19.69	20.1	20.4	20.56	20.61	20.6	20.51	20.16	19.63	19.14	(92)

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

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(93)m=	19.17	19.36	19.69	20.1	20.4	20.56	20.61	20.6	20.51	20.16	19.63	19.14	(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=	0.87	0.85	0.81	0.72	0.6	0.45	0.32	0.35	0.54	0.73	0.84	0.88	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	499.62	512.96	508.66	478.8	410.76	298.75	206.82	215.1	310.96	403.92	455.18	487.35	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	811.9	787.22	715.83	599.28	464.16	313.64	210.7	220.36	338.97	510.13	672.58	806.32	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	232.34	184.31	154.14	86.75	39.73	0	0	0	0	79.02	156.53	237.32	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1170.12	(98)
Space heating requirement in kWh/m²/year	18.33	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

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

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1170.12	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1228.63	(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		2038.34	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2140.25	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	33.69	(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		221.43	(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) =	221.43	(331)
Energy for lighting (calculated in Appendix L)		317.66	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-642.21	(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 =	52.09	(340a)
Water heating from CHP	(310a) x	4.24	x 0.01 =	90.75	(342a)
		Fuel Price			
Pumps and fans	(331)	13.19	x 0.01 =	29.21	(349)
Energy for lighting	(332)	13.19	x 0.01 =	41.9	(350)
Additional standing charges (Table 12)				120	(351)
Energy saving/generation technologies					
Total energy cost	= (340a)…(342e) + (345)…(354) =			333.95	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.29	(357)
SAP rating (section12)		82.02	(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 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			94	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	774.13	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	17.48	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	791.61	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			791.61	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	114.92	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	164.87	(379)
Energy saving/generation technologies (333) to (334) as applicable					
Item 1		0.52	x 0.01 =	-333.31	(380)
Total CO2, kg/year	sum of (376)…(382) =			738.09	(383)

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Dwelling CO2 Emission Rate	(383) ÷ (4) =			11.56	(384)
EI rating (section 14)				90.91	(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 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				94	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		1.22	=	4372.37	(367)
Electrical energy for heat distribution	[(313) x			=	103.42	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	4475.8	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)					4475.8	(373)
Energy associated with space heating (secondary)	(309) x		0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x		1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =				4475.8	(376)
Energy associated with space cooling	(315) x		3.07	=	0	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x		3.07	=	679.78	(378)
Energy associated with electricity for lighting	(332))) x		3.07	=	975.22	(379)
Energy saving/generation technologies						
Item 1		3.07		x 0.01 =	-1971.59	(380)
Total Primary Energy, kWh/year	sum of (376)…(382) =				4159.21	(383)

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User Details:

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

Property Address: Plot 45

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	63.82	(1a) x	2.5	(2a) =	159.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.82	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	159.56	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

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

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

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

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

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

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

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

(25)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1	=	2			(26)
Windows Type 1			1.696	x1/[1/(1.4)+ 0.04]		=	2.25			(27)
Windows Type 2			6.097	x1/[1/(1.4)+ 0.04]		=	8.08			(27)
Walls Type1	20.38	7.79	12.58	x	0.18	=	2.27			(29)
Walls Type2	28.8	2	26.8	x	0.18	=	4.82			(29)
Walls Type3	18.13	0	18.13	x	0.18	=	3.26			(29)
Roof	63.82	0	63.82	x	0.13	=	8.3			(30)
Total area of elements, m²			131.13							(31)

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.98 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1379.58 (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 10.73 (36)

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

Total fabric heat loss (33) + (36) = 41.71 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.95	29.81	29.67	29.02	28.9	28.34	28.34	28.23	28.55	28.9	29.15	29.4	(38)

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

(39)m=	71.66	71.52	71.38	70.73	70.61	70.05	70.05	69.95	70.27	70.61	70.86	71.12	

Average = $Sum(39)_{1\ldots12}$ /12= 70.73 (39)

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

(40)m=	1.12	1.12	1.12	1.11	1.11	1.1	1.1	1.1	1.1	1.11	1.11	1.11

Average = Sum(40)1…12 /12= 1.11 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.09 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 83.78 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	92.15	88.8	85.45	82.1	78.75	75.4	75.4	78.75	82.1	85.45	88.8	92.15	
											Total = Sum(44)1…12 =	1005.31	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	136.66	119.52	123.34	107.53	103.18	89.03	82.5	94.67	95.8	111.65	121.88	132.35	
											Total = Sum(45)1…12 =	1318.12	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.5	17.93	18.5	16.13	15.48	13.36	12.38	14.2	14.37	16.75	18.28	19.85	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.39 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0.75 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0.75 (55)

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

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

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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

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

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

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

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

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

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

(62)m=	183.26	161.61	169.93	152.62	149.77	134.13	129.1	141.27	140.9	158.25	166.97	178.94	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	183.26	161.61	169.93	152.62	149.77	134.13	129.1	141.27	140.9	158.25	166.97	178.94	

Output from water heater (annual) $_{1…12}$ 1866.74 (64)

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

(65)m=	82.72	73.41	78.29	71.83	71.58	65.68	64.71	68.75	67.93	74.4	76.6	81.28	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	104.37	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.99	15.98	12.99	9.84	7.35	6.21	6.71	8.72	11.7	14.86	17.34	18.49	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	182.48	184.37	179.6	169.44	156.62	144.56	136.51	134.62	139.39	149.55	162.37	174.42	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	33.44	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	-83.5	(71)
Water heating gains (Table 5)													
(72)m=	111.18	109.24	105.22	99.76	96.21	91.22	86.97	92.41	94.35	100	106.38	109.25	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	368.95	366.9	355.12	336.35	317.49	299.3	287.51	293.06	302.75	321.72	343.41	359.47	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a	g_ Table 6b		FF Table 6c		Gains (W)	
Southwest 0.9x	0.77	x	1.7	x	36.79	0.63	x	0.7	=	19.07	(79)
Southwest 0.9x	0.77	x	1.7	x	62.67	0.63	x	0.7	=	32.48	(79)
Southwest 0.9x	0.77	x	1.7	x	85.75	0.63	x	0.7	=	44.45	(79)
Southwest 0.9x	0.77	x	1.7	x	106.25	0.63	x	0.7	=	55.07	(79)
Southwest 0.9x	0.77	x	1.7	x	119.01	0.63	x	0.7	=	61.69	(79)

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Southwest 0.9x	0.77	x	1.7	x	118.15		0.63	x	0.7	=	61.24	(79)
Southwest 0.9x	0.77	x	1.7	x	113.91		0.63	x	0.7	=	59.04	(79)
Southwest 0.9x	0.77	x	1.7	x	104.39		0.63	x	0.7	=	54.11	(79)
Southwest 0.9x	0.77	x	1.7	x	92.85		0.63	x	0.7	=	48.13	(79)
Southwest 0.9x	0.77	x	1.7	x	69.27		0.63	x	0.7	=	35.9	(79)
Southwest 0.9x	0.77	x	1.7	x	44.07		0.63	x	0.7	=	22.84	(79)
Southwest 0.9x	0.77	x	1.7	x	31.49		0.63	x	0.7	=	16.32	(79)
Northwest 0.9x	0.77	x	6.1	x	11.28	x	0.63	x	0.7	=	21.02	(81)
Northwest 0.9x	0.77	x	6.1	x	22.97	x	0.63	x	0.7	=	42.79	(81)
Northwest 0.9x	0.77	x	6.1	x	41.38	x	0.63	x	0.7	=	77.1	(81)
Northwest 0.9x	0.77	x	6.1	x	67.96	x	0.63	x	0.7	=	126.62	(81)
Northwest 0.9x	0.77	x	6.1	x	91.35	x	0.63	x	0.7	=	170.21	(81)
Northwest 0.9x	0.77	x	6.1	x	97.38	x	0.63	x	0.7	=	181.46	(81)
Northwest 0.9x	0.77	x	6.1	x	91.1	x	0.63	x	0.7	=	169.75	(81)
Northwest 0.9x	0.77	x	6.1	x	72.63	x	0.63	x	0.7	=	135.33	(81)
Northwest 0.9x	0.77	x	6.1	x	50.42	x	0.63	x	0.7	=	93.95	(81)
Northwest 0.9x	0.77	x	6.1	x	28.07	x	0.63	x	0.7	=	52.3	(81)
Northwest 0.9x	0.77	x	6.1	x	14.2	x	0.63	x	0.7	=	26.45	(81)
Northwest 0.9x	0.77	x	6.1	x	9.21	x	0.63	x	0.7	=	17.17	(81)

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

(83)m=	40.09	75.28	121.55	181.7	231.89	242.7	228.79	189.43	142.08	88.2	49.3	33.49	(83)

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

(84)m=	409.05	442.18	476.67	518.04	549.39	542	516.3	482.5	444.83	409.92	392.71	392.96	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.75	0.58	0.64	0.87	0.98	0.99	1	(86)

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

(87)m=	19.83	19.95	20.17	20.48	20.76	20.94	20.99	20.98	20.86	20.51	20.12	19.81	(87)

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

(88)m=	19.98	19.98	19.99	19.99	20	20	20	20	20	20	19.99	19.99	(88)

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

(89)m=	1	0.99	0.99	0.96	0.86	0.66	0.46	0.51	0.81	0.97	0.99	1	(89)

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

(90)m=	18.43	18.6	18.92	19.37	19.75	19.96	20	20	19.88	19.42	18.86	18.4	(90)

fLA = Living area ÷ (4) = 0.51 (91)

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

(92)m=	19.14	19.28	19.55	19.93	20.26	20.45	20.5	20.49	20.37	19.97	19.49	19.11	(92)

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

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(93)m=	19.14	19.28	19.55	19.93	20.26	20.45	20.5	20.49	20.37	19.97	19.49	19.11	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.88	0.7	0.52	0.58	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	407.16	438.84	469.11	495.32	481.09	381.82	268.31	278.33	371.44	396.15	389.3	391.48	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1063.43	1028.49	931.47	779.99	604.69	410.1	273.03	286.25	440.82	661.38	878.23	1060.67	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	488.27	396.24	343.99	204.97	91.96	0	0	0	0	197.33	352.03	497.88	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2572.66 (98)

Space heating requirement in kWh/m²/year 40.31 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	488.27	396.24	343.99	204.97	91.96	0	0	0	0	197.33	352.03	497.88	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	522.21	423.79	367.91	219.21	98.36	0	0	0	0	211.04	376.51	532.49	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2751.51 (211)

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

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

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

Water heating

Output from water heater (calculated above)

	183.26	161.61	169.93	152.62	149.77	134.13	129.1	141.27	140.9	158.25	166.97	178.94	
Efficiency of water heater												79.8	(216)
(217)m=	87.31	87.12	86.66	85.6	83.56	79.8	79.8	79.8	79.8	85.4	86.76	87.4	(217)

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

(219)m=	209.9	185.51	196.1	178.29	179.24	168.08	161.78	177.03	176.56	185.29	192.45	204.74

Total = Sum(219a)$_{1...12}$ = 2214.97 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2751.51

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Water heating fuel used			2214.97	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			317.66	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	594.33	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	478.43	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1072.76	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	164.87	(268)
Total CO2, kg/year			sum of (265)…(271) =		1276.55	(272)

TER =	20	(273)