Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
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Project Information:

Assessed By:	Ben Tunningley (STRO027495)	**Building Type:**	End-terrace House

Dwelling Details:

NEW DWELLING AS BUILT		Total Floor Area: 74.1m²	
Site Reference :	Albany Farm	**Plot Reference:**	Plot 035
Address :	21 Buttercup Road , Bishops Waltham, SOUTHAMPTON, SO32 1RF		

Client Details:

Name:	Bargate Homes
Address :	The New Barn, Vicarage Farm Business Par, Winchester Road, Fair Oak, SO50 7HD

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
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	18.68 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	13.74 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	50.6 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	43.3 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	**OK**
Party wall	0.00 (max. 0.20)	-	**OK**
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	**OK**
Roof	0.11 (max. 0.20)	0.11 (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	4.48	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system:	Database: (rev 478, product index 017929): Boiler systems with radiators or underfloor heating - mains gas Brand name: Ideal Model: LOGIC COMBI Model qualifier: ESP1 35 (Combi) Efficiency 89.6 % SEDBUK2009 Minimum 88.0 %	**OK**
Secondary heating system:	None	

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5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	Programmer, room thermostat and TRVs	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

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

8 Mechanical ventilation

Continuous extract system (decentralised)		
Specific fan power:	0.16 0.18	
Maximum	0.7	OK

9 Summertime temperature

Overheating risk (South England):	Slight	OK

Based on:

Overshading:	Very Little
Windows facing: North West	3.06m²
Windows facing: South East	6.51m²
Ventilation rate:	4.00
Blinds/curtains:	None

10 Key features

Roofs U-value	0.11 W/m²K
Party Walls U-value	0 W/m²K
Floors U-value	0.11 W/m²K
Photovoltaic array	

SAP WorkSheet: New dwelling as built

User Details:

Assessor Name:	Ben Tunningley	**Stroma Number:**	STRO027495
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Plot 035

Address : 21 Buttercup Road , Bishops Waltham, SOUTHAMPTON, SO32 1RF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	37.05	(1a)	x	2.4	(2a)	=	88.92	(3a)
First floor	37.05	(1b)	x	2.67	(2b)	=	98.92	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.1	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	187.84	(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		4.48000001907349	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.22	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.19	(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

SAP WorkSheet: New dwelling as built

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

0.24	0.24	0.23	0.21	0.2	0.18	0.18	0.18	0.19	0.2	0.21	0.22

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) = 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=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.1	x	1.4	=	2.94			(26)
Windows Type 1			3.06	x1/[1/(1.4)+ 0.04]		=	4.06			(27)
Windows Type 2			6.51	x1/[1/(1.4)+ 0.04]		=	8.63			(27)
Floor			37.05	x	0.11	=	4.0755	75	2778.75	(28)
Walls	87.39	11.67	75.72	x	0.24	=	18.17	60	4543.2	(29)
Roof	37.05	0	37.05	x	0.11	=	4.08	9	333.45	(30)
Total area of elements, m²			161.49							(31)
Party wall			42.73	x	0	=	0	45	1922.85	(32)
Internal wall **			59.9					9	539.136	(32c)
Internal wall **			90.09					9	810.7722	(32c)
Internal floor			37.05					18	666.9	(32d)
Internal ceiling			37.05					9	333.45	(32e)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.95 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 11928.51 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 160.98 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 6.75 | (36)

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

Total fabric heat loss (33) + (36) = | 48.7 | (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=	30.99	30.99	30.99	30.99	30.99	30.99	30.99	30.99	30.99	30.99	30.99	30.99	(38)

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

(39)m=	79.69	79.69	79.69	79.69	79.69	79.69	79.69	79.69	79.69	79.69	79.69	79.69	

Average = Sum(39)$_{1...12}$ /12= | 79.69 | (39)

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

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

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 | 2.34 | (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 89.81 | (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	98.79	95.2	91.6	88.01	84.42	80.83	80.83	84.42	88.01	91.6	95.2	98.79	

Total = Sum(44)$_{1...12}$ = | 1077.7 | (44)

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

(45)m=	146.5	128.13	132.22	115.27	110.61	95.45	88.44	101.49	102.7	119.69	130.65	141.88	

Total = Sum(45)$_{1...12}$ = | 1413.04 | (45)

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

(46)m=	21.98	19.22	19.83	17.29	16.59	14.32	13.27	15.22	15.41	17.95	19.6	21.28	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) 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=	13.76	12.43	13.76	13.31	13.76	13.31	13.76	13.76	13.31	13.76	13.31	13.76	(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=	160.26	140.56	145.98	128.59	124.36	108.76	102.2	115.25	116.02	133.45	143.96	155.64	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	160.26	140.56	145.98	128.59	124.36	108.76	102.2	115.25	116.02	133.45	143.96	155.64	

Output from water heater (annual)$_{1\ldots12}$ 1575.01 (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=	52.15	45.71	47.4	41.66	40.22	35.06	32.85	37.18	37.48	43.24	46.77	50.61	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	140.48	140.48	140.48	140.48	140.48	140.48	140.48	140.48	140.48	140.48	140.48	140.48	(66)

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

(67)m=	48.32	42.92	34.91	26.43	19.75	16.68	18.02	23.42	31.44	39.92	46.59	49.67	(67)

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

(68)m=	308.46	311.67	303.6	286.43	264.75	244.38	230.77	227.57	235.63	252.8	274.48	294.85	(68)

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

(69)m=	51.39	51.39	51.39	51.39	51.39	51.39	51.39	51.39	51.39	51.39	51.39	51.39	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	(71)

Water heating gains (Table 5)

(72)m=	70.1	68.02	63.71	57.86	54.05	48.7	44.15	49.98	52.05	58.11	64.96	68.03	(72)

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

(73)m=	528.1	523.83	503.44	471.93	439.78	410.97	394.16	402.19	420.34	452.06	487.25	513.77	(73)

SAP WorkSheet: New dwelling as built

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	1	x	6.51	x	36.79	x	0.45	x	1.11	=	107.79	(77)
Southeast 0.9x	1	x	6.51	x	62.67	x	0.45	x	1.11	=	183.6	(77)
Southeast 0.9x	1	x	6.51	x	85.75	x	0.45	x	1.11	=	251.21	(77)
Southeast 0.9x	1	x	6.51	x	106.25	x	0.45	x	1.11	=	311.26	(77)
Southeast 0.9x	1	x	6.51	x	119.01	x	0.45	x	1.11	=	348.64	(77)
Southeast 0.9x	1	x	6.51	x	118.15	x	0.45	x	1.11	=	346.12	(77)
Southeast 0.9x	1	x	6.51	x	113.91	x	0.45	x	1.11	=	333.7	(77)
Southeast 0.9x	1	x	6.51	x	104.39	x	0.45	x	1.11	=	305.81	(77)
Southeast 0.9x	1	x	6.51	x	92.85	x	0.45	x	1.11	=	272.01	(77)
Southeast 0.9x	1	x	6.51	x	69.27	x	0.45	x	1.11	=	202.92	(77)
Southeast 0.9x	1	x	6.51	x	44.07	x	0.45	x	1.11	=	129.1	(77)
Southeast 0.9x	1	x	6.51	x	31.49	x	0.45	x	1.11	=	92.24	(77)
Northwest 0.9x	1	x	3.06	x	11.28	x	0.45	x	1.11	=	15.54	(81)
Northwest 0.9x	1	x	3.06	x	22.97	x	0.45	x	1.11	=	31.63	(81)
Northwest 0.9x	1	x	3.06	x	41.38	x	0.45	x	1.11	=	56.98	(81)
Northwest 0.9x	1	x	3.06	x	67.96	x	0.45	x	1.11	=	93.58	(81)
Northwest 0.9x	1	x	3.06	x	91.35	x	0.45	x	1.11	=	125.78	(81)
Northwest 0.9x	1	x	3.06	x	97.38	x	0.45	x	1.11	=	134.1	(81)
Northwest 0.9x	1	x	3.06	x	91.1	x	0.45	x	1.11	=	125.45	(81)
Northwest 0.9x	1	x	3.06	x	72.63	x	0.45	x	1.11	=	100.01	(81)
Northwest 0.9x	1	x	3.06	x	50.42	x	0.45	x	1.11	=	69.43	(81)
Northwest 0.9x	1	x	3.06	x	28.07	x	0.45	x	1.11	=	38.65	(81)
Northwest 0.9x	1	x	3.06	x	14.2	x	0.45	x	1.11	=	19.55	(81)
Northwest 0.9x	1	x	3.06	x	9.21	x	0.45	x	1.11	=	12.69	(81)

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

(83)m=	123.32	215.23	308.19	404.84	474.43	480.22	459.14	405.82	341.44	241.57	148.65	104.93	(83)

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

(84)m=	651.43	739.05	811.63	876.77	914.2	891.19	853.3	808.01	761.78	693.62	635.9	618.7	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.96	0.94	0.9	0.83	0.7	0.54	0.4	0.44	0.65	0.85	0.94	0.97	(86)

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

(87)m=	19.74	19.95	20.24	20.57	20.82	20.95	20.99	20.98	20.9	20.58	20.09	19.67	(87)

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

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

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

(89)m=	0.96	0.93	0.89	0.79	0.65	0.47	0.32	0.35	0.58	0.82	0.93	0.96	(89)

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

(90)m=	18.89	19.09	19.38	19.68	19.9	19.99	20.02	20.01	19.96	19.69	19.23	18.83	(90)

fLA = Living area ÷ (4) = 0.2 (91)

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

(92)m=	19.06	19.27	19.55	19.86	20.09	20.19	20.21	20.21	20.15	19.87	19.41	19	(92)

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

(93)m=	18.91	19.12	19.4	19.71	19.94	20.04	20.06	20.06	20	19.72	19.26	18.85	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.95	0.92	0.87	0.78	0.64	0.47	0.32	0.36	0.57	0.81	0.92	0.95	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	617.2	680.1	708.1	686.95	589.53	418.3	273.47	287.79	437.99	560.92	584.36	590.84	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1164.55	1133.04	1028.28	861.64	656.3	433.47	276.13	291.83	470.46	727.17	968.95	1167.45	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	407.23	304.38	238.22	125.77	49.68	0	0	0	0	123.69	276.9	429	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1954.86 (98)

Space heating requirement in kWh/m²/year 26.38 (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		90.5	(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)													
	407.23	304.38	238.22	125.77	49.68	0	0	0	0	123.69	276.9	429	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	449.98	336.33	263.22	138.98	54.89	0	0	0	0	136.67	305.97	474.03	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2160.07 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

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Water heating

Output from water heater (calculated above)

	160.26	140.56	145.98	128.59	124.36	108.76	102.2	115.25	116.02	133.45	143.96	155.64		
Efficiency of water heater													87.3	(216)
(217)m=	89.57	89.46	89.26	88.85	88.19	87.3	87.3	87.3	87.3	88.81	89.38	89.63		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	178.91	157.11	163.55	144.72	141.02	124.58	117.07	132.01	132.89	150.26	161.07	173.65		
								Total = Sum(219a)$_{1...12}$ =					1776.84	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2160.07	
Water heating fuel used			1776.84	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		49.6		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		124.6	(231)
Electricity for lighting			341.37	(232)
Electricity generated by PVs			-481.92	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3920.97	(338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	75.17	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	61.83	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	16.43	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	45.03	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-63.57	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			254.9	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.9	(257)
SAP rating (Section 12)		87.46	(258)

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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	=	466.58	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	383.8	(264)
Space and water heating	(261) + (262) + (263) + (264) =				850.37	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	64.67	(267)
Electricity for lighting	(232)	x	0.519	=	177.17	(268)
Energy saving/generation technologies						
Item 1			0.519	=	-250.12	(269)
Total CO2, kg/year			sum of (265)…(271) =		842.1	(272)
CO2 emissions per m²			(272) ÷ (4) =		11.36	(273)
EI rating (section 14)					91	(274)

13a. Primary Energy

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	2635.29	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	2167.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4803.04	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	382.52	(267)
Electricity for lighting	(232)	x	0	=	1048.01	(268)
Energy saving/generation technologies						
Item 1			3.07	=	-1479.49	(269)
‘Total Primary Energy			sum of (265)…(271) =		4754.08	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		64.16	(273)

DER WorkSheet: New dwelling as built

User Details:

Assessor Name:	Ben Tunningley	**Stroma Number:**	STRO027495
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Plot 035

Address : 21 Buttercup Road , Bishops Waltham, SOUTHAMPTON, SO32 1RF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	37.05	(1a)	x	2.4	(2a)	=	88.92	(3a)
First floor	37.05	(1b)	x	2.67	(2b)	=	98.92	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.1	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	187.84	(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		4.48000001907349	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.22	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.19	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.24	0.24	0.23	0.21	0.2	0.18	0.18	0.18	0.19	0.2	0.21	0.22

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) = 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=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.1	x	1.4	=	2.94			(26)
Windows Type 1			3.06	x1/[1/(1.4)+ 0.04]		=	4.06			(27)
Windows Type 2			6.51	x1/[1/(1.4)+ 0.04]		=	8.63			(27)
Floor			37.05	x	0.11	=	4.0755	75	2778.75	(28)
Walls	87.39	11.67	75.72	x	0.24	=	18.17	60	4543.2	(29)
Roof	37.05	0	37.05	x	0.11	=	4.08	9	333.45	(30)
Total area of elements, m²			161.49							(31)
Party wall			42.73	x	0	=	0	45	1922.85	(32)
Internal wall **			59.9					9	539.136	(32c)
Internal wall **			90.09					9	810.7722	(32c)
Internal floor			37.05					18	666.9	(32d)
Internal ceiling			37.05					9	333.45	(32e)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.95 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 11928.51 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 160.98 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 6.75 (36)

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

Total fabric heat loss — (33) + (36) = 48.7 (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=	30.99	30.99	30.99	30.99	30.99	30.99	30.99	30.99	30.99	30.99	30.99	30.99	(38)

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

(39)m=	79.69	79.69	79.69	79.69	79.69	79.69	79.69	79.69	79.69	79.69	79.69	79.69	

Average = $Sum(39)_{1...12}$ /12= 79.69 (39)

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

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

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 — 2.34 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 89.81 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	98.79	95.2	91.6	88.01	84.42	80.83	80.83	84.42	88.01	91.6	95.2	98.79	
												Total = $Sum(44)_{1...12}$ = 1077.7	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	146.5	128.13	132.22	115.27	110.61	95.45	88.44	101.49	102.7	119.69	130.65	141.88	
												Total = $Sum(45)_{1...12}$ = 1413.04	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	21.98	19.22	19.83	17.29	16.59	14.32	13.27	15.22	15.41	17.95	19.6	21.28	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) 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)

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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=	13.76	12.43	13.76	13.31	13.76	13.31	13.76	13.76	13.31	13.76	13.31	13.76	(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=	160.26	140.56	145.98	128.59	124.36	108.76	102.2	115.25	116.02	133.45	143.96	155.64	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	160.26	140.56	145.98	128.59	124.36	108.76	102.2	115.25	116.02	133.45	143.96	155.64	

Output from water heater (annual)$_{1...12}$ — 1575.01 — (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=	52.15	45.71	47.4	41.66	40.22	35.06	32.85	37.18	37.48	43.24	46.77	50.61	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	(66)

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

(67)m=	20.12	17.87	14.53	11	8.22	6.94	7.5	9.75	13.09	16.62	19.4	20.68	(67)

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

(68)m=	206.67	208.82	203.41	191.91	177.38	163.73	154.61	152.47	157.87	169.38	183.9	197.55	(68)

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

(69)m=	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	(71)

Water heating gains (Table 5)

(72)m=	70.1	68.02	63.71	57.86	54.05	48.7	44.15	49.98	52.05	58.11	64.96	68.03	(72)

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

(73)m=	358.01	355.83	342.78	321.89	300.78	280.5	267.39	273.32	284.14	305.23	329.38	347.38	(73)

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6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	0.77	x	6.51	x	36.79	x	0.45	x	1.11	=	83	(77)
Southeast	0.9x	0.77	x	6.51	x	62.67	x	0.45	x	1.11	=	141.37	(77)
Southeast	0.9x	0.77	x	6.51	x	85.75	x	0.45	x	1.11	=	193.43	(77)
Southeast	0.9x	0.77	x	6.51	x	106.25	x	0.45	x	1.11	=	239.67	(77)
Southeast	0.9x	0.77	x	6.51	x	119.01	x	0.45	x	1.11	=	268.45	(77)
Southeast	0.9x	0.77	x	6.51	x	118.15	x	0.45	x	1.11	=	266.51	(77)
Southeast	0.9x	0.77	x	6.51	x	113.91	x	0.45	x	1.11	=	256.95	(77)
Southeast	0.9x	0.77	x	6.51	x	104.39	x	0.45	x	1.11	=	235.48	(77)
Southeast	0.9x	0.77	x	6.51	x	92.85	x	0.45	x	1.11	=	209.45	(77)
Southeast	0.9x	0.77	x	6.51	x	69.27	x	0.45	x	1.11	=	156.25	(77)
Southeast	0.9x	0.77	x	6.51	x	44.07	x	0.45	x	1.11	=	99.41	(77)
Southeast	0.9x	0.77	x	6.51	x	31.49	x	0.45	x	1.11	=	71.03	(77)
Northwest	0.9x	0.77	x	3.06	x	11.28	x	0.45	x	1.11	=	11.96	(81)
Northwest	0.9x	0.77	x	3.06	x	22.97	x	0.45	x	1.11	=	24.35	(81)
Northwest	0.9x	0.77	x	3.06	x	41.38	x	0.45	x	1.11	=	43.87	(81)
Northwest	0.9x	0.77	x	3.06	x	67.96	x	0.45	x	1.11	=	72.05	(81)
Northwest	0.9x	0.77	x	3.06	x	91.35	x	0.45	x	1.11	=	96.85	(81)
Northwest	0.9x	0.77	x	3.06	x	97.38	x	0.45	x	1.11	=	103.26	(81)
Northwest	0.9x	0.77	x	3.06	x	91.1	x	0.45	x	1.11	=	96.59	(81)
Northwest	0.9x	0.77	x	3.06	x	72.63	x	0.45	x	1.11	=	77.01	(81)
Northwest	0.9x	0.77	x	3.06	x	50.42	x	0.45	x	1.11	=	53.46	(81)
Northwest	0.9x	0.77	x	3.06	x	28.07	x	0.45	x	1.11	=	29.76	(81)
Northwest	0.9x	0.77	x	3.06	x	14.2	x	0.45	x	1.11	=	15.05	(81)
Northwest	0.9x	0.77	x	3.06	x	9.21	x	0.45	x	1.11	=	9.77	(81)

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

(83)m=	94.96	165.72	237.31	311.73	365.31	369.77	353.54	312.48	262.91	186.01	114.46	80.8	(83)

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

(84)m=	452.97	521.55	580.09	633.61	666.09	650.27	620.93	585.8	547.04	491.24	443.84	428.18	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.92	0.83	0.69	0.53	0.58	0.79	0.94	0.98	0.99	(86)

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

(87)m=	19.41	19.61	19.93	20.31	20.66	20.88	20.97	20.95	20.79	20.34	19.79	19.36	(87)

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

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

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

(89)m=	0.99	0.98	0.95	0.9	0.79	0.61	0.43	0.47	0.73	0.92	0.98	0.99	(89)

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

(90)m=	18.57	18.77	19.08	19.45	19.77	19.96	20.01	20	19.89	19.48	18.95	18.52	(90)

fLA = Living area ÷ (4) = 0.2 (91)

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

(92)m=	18.74	18.94	19.25	19.63	19.96	20.15	20.2	20.2	20.07	19.66	19.12	18.69	(92)

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

(93)m=	18.59	18.79	19.1	19.48	19.81	20	20.05	20.05	19.92	19.51	18.97	18.54	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.94	0.89	0.78	0.61	0.43	0.48	0.72	0.91	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	444.44	504.96	546.74	561.56	518.29	394.47	268	279.82	394.49	445.64	429.9	421.51	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1139.09	1107.05	1004.2	843	645.91	430.02	275.28	290.61	464.09	709.92	946.01	1142.57	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	516.82	404.61	340.35	202.64	94.95	0	0	0	0	196.63	371.6	536.46	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2664.05 (98)

Space heating requirement in kWh/m²/year 35.95 (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		90.5	(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)													
	516.82	404.61	340.35	202.64	94.95	0	0	0	0	196.63	371.6	536.46	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	571.07	447.08	376.08	223.91	104.92	0	0	0	0	217.27	410.6	592.78	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2943.7 (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)

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Water heating

Output from water heater (calculated above)

	160.26	140.56	145.98	128.59	124.36	108.76	102.2	115.25	116.02	133.45	143.96	155.64		
Efficiency of water heater													87.3	(216)
(217)m=	89.72	89.65	89.52	89.23	88.66	87.3	87.3	87.3	87.3	89.18	89.58	89.76		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	178.62	156.78	163.08	144.11	140.27	124.58	117.07	132.01	132.89	149.64	160.71	173.39		
								Total = Sum(219a)$_{1...12}$ =					1773.14	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2943.7	
Water heating fuel used			1773.14	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		49.6		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		124.6	(231)
Electricity for lighting			355.33	(232)
Electricity generated by PVs			-481.92	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4714.86	(338)

12a. CO_2 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	=	635.84	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	383	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1018.84	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	64.67	(267)
Electricity for lighting	(232) x	0.519	=	184.42	(268)
Energy saving/generation technologies Item 1		0.519	=	-250.12	(269)
Total CO2, kg/year		sum of (265)…(271) =		1017.81	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.74	(273)
EI rating (section 14)				89	(274)

TER WorkSheet: New dwelling as built

User Details:

Assessor Name:	Ben Tunningley	**Stroma Number:**	STRO027495
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Plot 035

Address : 21 Buttercup Road , Bishops Waltham, SOUTHAMPTON, SO32 1RF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	37.05	(1a)	x	2.4	(2a)	=	88.92	(3a)
First floor	37.05	(1b)	x	2.67	(2b)	=	98.92	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.1	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	187.84	(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							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.16	(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)	0.41	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.44	0.44	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 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=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(24d)

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

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (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			2.1	x	1	=	2.1			(26)
Windows Type 1			3.06	x1/[1/(1.4)+ 0.04]		=	4.06			(27)
Windows Type 2			6.51	x1/[1/(1.4)+ 0.04]		=	8.63			(27)
Floor			37.05	x	0.13	=	4.8165			(28)
Walls	87.39	11.67	75.72	x	0.18	=	13.63			(29)
Roof	37.05	0	37.05	x	0.13	=	4.82			(30)
Total area of elements, m²			161.49							(31)
Party wall			42.73	x	0	=	0			(32)
Internal wall **			59.9							(32c)
Internal wall **			90.09							(32c)
Internal floor			37.05							(32d)
Internal ceiling			37.05							(32e)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 38.05 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 11928.51 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 8.65 | (36)

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

Total fabric heat loss (33) + (36) = | 46.7 | (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=	37.1	36.87	36.63	35.54	35.34	34.39	34.39	34.21	34.75	35.34	35.75	36.18	(38)

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

(39)m=	83.8	83.56	83.33	82.24	82.04	81.08	81.08	80.91	81.45	82.04	82.45	82.88

Average = Sum(39)$_{1...12}$ /12= | 82.24 | (39)

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

(40)m=	1.13	1.13	1.12	1.11	1.11	1.09	1.09	1.09	1.1	1.11	1.11	1.12

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 | 2.34 | (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 89.81 | (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	98.79	95.2	91.6	88.01	84.42	80.83	80.83	84.42	88.01	91.6	95.2	98.79

Total = Sum(44)$_{1...12}$ = | 1077.7 | (44)

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

(45)m=	146.5	128.13	132.22	115.27	110.61	95.45	88.44	101.49	102.7	119.69	130.65	141.88

Total = Sum(45)$_{1...12}$ = | 1413.04 | (45)

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

(46)m=	21.98	19.22	19.83	17.29	16.59	14.32	13.27	15.22	15.41	17.95	19.6	21.28	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) 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)

TER WorkSheet: New dwelling as built

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=	50.34	43.82	46.68	43.4	43.02	39.86	41.19	43.02	43.4	46.68	46.95	50.34	(61)

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

(62)m=	196.84	171.95	178.9	158.68	153.63	135.31	129.63	144.51	146.11	166.37	177.6	192.22	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	196.84	171.95	178.9	158.68	153.63	135.31	129.63	144.51	146.11	166.37	177.6	192.22	

Output from water heater (annual)$_{1...12}$ 1951.74 (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=	61.3	53.56	55.63	49.18	47.53	41.7	39.7	44.5	45	51.47	55.18	59.76	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	(66)

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

(67)m=	20.12	17.87	14.53	11	8.22	6.94	7.5	9.75	13.09	16.62	19.4	20.68	(67)

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

(68)m=	206.67	208.82	203.41	191.91	177.38	163.73	154.61	152.47	157.87	169.38	183.9	197.55	(68)

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

(69)m=	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	(71)

Water heating gains (Table 5)

(72)m=	82.39	79.7	74.78	68.3	63.89	57.92	53.37	59.81	62.5	69.18	76.64	80.32	(72)

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

(73)m=	370.3	367.51	353.84	332.33	310.62	289.72	276.61	283.16	294.58	316.3	341.06	359.68	(73)

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6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	6.51	x	36.79	x	0.63	x	0.7	=	73.2	(77)
Southeast 0.9x	0.77	x	6.51	x	62.67	x	0.63	x	0.7	=	124.69	(77)
Southeast 0.9x	0.77	x	6.51	x	85.75	x	0.63	x	0.7	=	170.61	(77)
Southeast 0.9x	0.77	x	6.51	x	106.25	x	0.63	x	0.7	=	211.39	(77)
Southeast 0.9x	0.77	x	6.51	x	119.01	x	0.63	x	0.7	=	236.78	(77)
Southeast 0.9x	0.77	x	6.51	x	118.15	x	0.63	x	0.7	=	235.06	(77)
Southeast 0.9x	0.77	x	6.51	x	113.91	x	0.63	x	0.7	=	226.63	(77)
Southeast 0.9x	0.77	x	6.51	x	104.39	x	0.63	x	0.7	=	207.69	(77)
Southeast 0.9x	0.77	x	6.51	x	92.85	x	0.63	x	0.7	=	184.73	(77)
Southeast 0.9x	0.77	x	6.51	x	69.27	x	0.63	x	0.7	=	137.81	(77)
Southeast 0.9x	0.77	x	6.51	x	44.07	x	0.63	x	0.7	=	87.68	(77)
Southeast 0.9x	0.77	x	6.51	x	31.49	x	0.63	x	0.7	=	62.65	(77)
Northwest 0.9x	0.77	x	3.06	x	11.28	x	0.63	x	0.7	=	10.55	(81)
Northwest 0.9x	0.77	x	3.06	x	22.97	x	0.63	x	0.7	=	21.48	(81)
Northwest 0.9x	0.77	x	3.06	x	41.38	x	0.63	x	0.7	=	38.7	(81)
Northwest 0.9x	0.77	x	3.06	x	67.96	x	0.63	x	0.7	=	63.55	(81)
Northwest 0.9x	0.77	x	3.06	x	91.35	x	0.63	x	0.7	=	85.42	(81)
Northwest 0.9x	0.77	x	3.06	x	97.38	x	0.63	x	0.7	=	91.07	(81)
Northwest 0.9x	0.77	x	3.06	x	91.1	x	0.63	x	0.7	=	85.2	(81)
Northwest 0.9x	0.77	x	3.06	x	72.63	x	0.63	x	0.7	=	67.92	(81)
Northwest 0.9x	0.77	x	3.06	x	50.42	x	0.63	x	0.7	=	47.15	(81)
Northwest 0.9x	0.77	x	3.06	x	28.07	x	0.63	x	0.7	=	26.25	(81)
Northwest 0.9x	0.77	x	3.06	x	14.2	x	0.63	x	0.7	=	13.28	(81)
Northwest 0.9x	0.77	x	3.06	x	9.21	x	0.63	x	0.7	=	8.62	(81)

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

(83)m=	83.75	146.17	209.3	274.94	322.2	326.14	311.82	275.61	231.88	164.06	100.96	71.26	(83)

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

(84)m=	454.06	513.68	563.15	607.28	632.82	615.85	588.43	558.76	526.47	480.36	442.02	430.94	(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	0.91	0.76	0.59	0.64	0.87	0.98	1	1	(86)

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

(87)m=	19.8	19.94	20.17	20.48	20.76	20.93	20.99	20.98	20.86	20.51	20.1	19.77	(87)

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

(88)m=	19.98	19.98	19.98	19.99	20	20.01	20.01	20.01	20	20	19.99	19.99	(88)

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

(89)m=	1	0.99	0.99	0.96	0.87	0.67	0.46	0.51	0.8	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=	18.37	18.58	18.92	19.37	19.75	19.96	20	20	19.89	19.42	18.82	18.35	(90)

fLA = Living area ÷ (4) = 0.2 (91)

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

(92)m=	18.66	18.86	19.18	19.6	19.95	20.16	20.2	20.2	20.09	19.64	19.09	18.64	(92)

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

(93)m=	18.66	18.86	19.18	19.6	19.95	20.16	20.2	20.2	20.09	19.64	19.09	18.64	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.87	0.69	0.49	0.54	0.81	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	452.08	509.28	552.4	576.5	547.54	423.22	288.24	301.21	423.98	461.25	438.15	429.49	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1203.67	1166.48	1056.34	879.86	677.19	450.78	292.06	307.39	487.73	741.9	988.2	1196.62	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	559.19	441.64	374.93	218.42	96.46	0	0	0	0	208.8	396.04	570.75	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2866.22 (98)

Space heating requirement in kWh/m²/year 38.68 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(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)													
	559.19	441.64	374.93	218.42	96.46	0	0	0	0	208.8	396.04	570.75	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	598.7	472.84	401.42	233.85	103.27	0	0	0	0	223.56	424.02	611.08	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3068.76 (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)

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Water heating

Output from water heater (calculated above)

196.84	171.95	178.9	158.68	153.63	135.31	129.63	144.51	146.11	166.37	177.6	192.22

Efficiency of water heater: 80.3 (216)

(217)m=	87.53	87.32	86.87	85.86	83.92	80.3	80.3	80.3	80.3	85.62	87.01	87.62	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	224.88	196.91	205.94	184.82	183.07	168.5	161.44	179.96	181.95	194.3	204.11	219.37

Total = Sum(219a)$_{1...12}$ = 2305.25 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3068.76	
Water heating fuel used		2305.25	
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		355.33	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5804.35	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	662.85	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	497.93	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1160.79	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	184.42	(268)
Total CO2, kg/year		sum of (265)…(271) =		1384.13	(272)

TER = 18.68 (273)