TER WorkSheet: New dwelling as built

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User Details:

Assessor Name:	James Mcglashan	**Stroma Number:**	STRO000976
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.5.0.95

Property Address: 22 ASHP

Address : Flat 22, Anello Building, 116 Bayham Street, LONDON, NW1 0BA

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)		Volume(m³)	
Ground floor	191.89	(1a) x	2.476	(2a) =	475.12	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	191.89	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	475.12	(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) =	0.06	(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		10	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.56	(18)

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

Number of sides on which sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.48	(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=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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

0.65	0.61	0.61	0.54	0.49	0.47	0.44	0.44	0.5	0.54	0.57	0.61

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=	0.71	0.69	0.69	0.64	0.62	0.61	0.6	0.6	0.63	0.64	0.66	0.69	(24d)

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

(25)m=	0.71	0.69	0.69	0.64	0.62	0.61	0.6	0.6	0.63	0.64	0.66	0.69	(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			1.85	x	2	=	3.7			(26)
Windows			46.1225	x	1/[1/(2)+ 0.04]	=	85.41			(27)
Walls	151.16	47.97	103.19	x	0.35	=	36.12			(29)
Roof	191.89	0	191.89	x	0.16	=	30.7			(30)
Total area of elements, m²			343.05							(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) = 155.93 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 1727.01 (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 37.74 (36)

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

Total fabric heat loss (33) + (36) = 193.67 (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=	111.13	107.59	107.59	101.13	97.27	95.47	93.76	93.76	98.2	101.13	104.26	107.59	(38)

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

(39)m=	304.8	301.26	301.26	294.79	290.93	289.14	287.43	287.43	291.86	294.79	297.93	301.26

Average = Sum(39)$_{1…12}$ /12= 295.24 (39)

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

(40)m=	1.59	1.57	1.57	1.54	1.52	1.51	1.5	1.5	1.52	1.54	1.55	1.57

Average = Sum(40)$_{1…12}$ /12= 1.54 (40)

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Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.99 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 110.78 (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=	121.86	117.43	113	108.57	104.14	99.71	99.71	104.14	108.57	113	117.43	121.86		
										Total = Sum(44)$_{1…12}$ =			1329.41	(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=	181.15	158.44	163.49	142.54	136.77	118.02	109.36	125.49	126.99	148	161.55	175.43		
										Total = Sum(45)$_{1…12}$ =			1747.23	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	27.17	23.77	24.52	21.38	20.52	17.7	16.4	18.82	19.05	22.2	24.23	26.32		(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (47)

Temperature factor from Table 2b 0 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0 (49)

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

Cylinder volume (litres) including any solar storage within same 150 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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

Volume factor from Table 2a 0.93 (52)

Temperature factor from Table 2b 0.54 (53)

Energy lost from water storage, kWh/year ((50) x (51) x (52) x (53) = 1.44 (54)

Enter (49) or (54) in (55) 1.44 (55)

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

(56)m=	44.53	40.22	44.53	43.09	44.53	43.09	44.53	44.53	43.09	44.53	43.09	44.53	(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=	44.53	40.22	44.53	43.09	44.53	43.09	44.53	44.53	43.09	44.53	43.09	44.53	(57)

Primary circuit loss (annual) from Table 3 610 (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=	51.81	46.79	51.81	50.14	51.81	50.14	51.81	51.81	50.14	51.81	50.14	51.81	(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=	277.49	245.45	259.83	235.76	233.1	211.25	205.7	221.83	220.22	244.33	254.78	271.77	(62)

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

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

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

Output from water heater

(64)m=	277.49	245.45	259.83	235.76	233.1	211.25	205.7	221.83	220.22	244.33	254.78	271.77	

Output from water heater (annual)$_{1...12}$ 2881.52 (64)

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

(65)m=	137.3	122.29	131.43	121.98	122.54	113.82	113.43	118.8	116.81	126.28	128.3	135.4	(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=	149.57	149.57	149.57	149.57	149.57	149.57	149.57	149.57	149.57	149.57	149.57	149.57	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	55.06	48.9	39.77	30.11	22.51	19	20.53	26.69	35.82	45.48	53.08	56.59	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	363.27	367.04	357.54	337.32	311.79	287.8	271.77	268	277.5	297.72	323.25	347.24	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	(69)
Pumps and fans gains (Table 5a)													
(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-119.65	-119.65	-119.65	-119.65	-119.65	-119.65	-119.65	-119.65	-119.65	-119.65	-119.65	-119.65	(71)
Water heating gains (Table 5)													
(72)m=	184.55	181.98	176.65	169.41	164.71	158.09	152.46	159.67	162.23	169.73	178.19	181.99	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	680.74	675.79	651.83	614.71	576.88	542.76	522.63	532.23	553.42	590.8	632.39	663.69	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x 1	x	46.12	x	19.87	x	0.72	x	0.7	=	320.13	(76)
East	0.9x 1	x	46.12	x	38.52	x	0.72	x	0.7	=	620.51	(76)
East	0.9x 1	x	46.12	x	61.57	x	0.72	x	0.7	=	991.77	(76)
East	0.9x 1	x	46.12	x	91.41	x	0.72	x	0.7	=	1472.55	(76)
East	0.9x 1	x	46.12	x	111.22	x	0.72	x	0.7	=	1791.67	(76)
East	0.9x 1	x	46.12	x	116.05	x	0.72	x	0.7	=	1869.52	(76)
East	0.9x 1	x	46.12	x	112.64	x	0.72	x	0.7	=	1814.58	(76)
East	0.9x 1	x	46.12	x	98.03	x	0.72	x	0.7	=	1579.27	(76)
East	0.9x 1	x	46.12	x	73.6	x	0.72	x	0.7	=	1185.71	(76)
East	0.9x 1	x	46.12	x	46.91	x	0.72	x	0.7	=	755.66	(76)

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East	0.9x	1	x	46.12	x	24.71	x	0.72	x	0.7	=	398.01 (76)
East	0.9x	1	x	46.12	x	16.39	x	0.72	x	0.7	=	264.08 (76)

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

(83)m=	320.13	620.51	991.77	1472.55	1791.67	1869.52	1814.58	1579.27	1185.71	755.66	398.01	264.08 (83)

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

(84)m=	1000.88	1296.3	1643.61	2087.26	2368.55	2412.28	2337.21	2111.5	1739.13	1346.46	1030.4	927.77 (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	0.95	0.85	0.68	0.49	0.53	0.85	0.98	1	1	(86)

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

(87)m=	19.17	19.4	19.79	20.25	20.68	20.91	20.98	20.98	20.78	20.23	19.57	19.22	(87)

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

(88)m=	19.63	19.64	19.64	19.66	19.68	19.69	19.69	19.69	19.68	19.66	19.65	19.64	(88)

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

(89)m=	1	0.99	0.98	0.93	0.79	0.58	0.34	0.38	0.76	0.96	1	1	(89)

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

(90)m=	17.99	18.22	18.61	19.08	19.48	19.65	19.69	19.69	19.56	19.06	18.4	18.04	(90)

fLA = Living area ÷ (4) = 0.57 (91)

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

(92)m=	18.67	18.89	19.29	19.75	20.17	20.37	20.43	20.42	20.26	19.73	19.07	18.71	(92)

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

(93)m=	18.67	18.89	19.29	19.75	20.17	20.37	20.43	20.42	20.26	19.73	19.07	18.71	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.93	0.82	0.64	0.43	0.47	0.8	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	998.36	1287.53	1607.82	1946.34	1936.25	1532.39	994.92	986.1	1393.96	1300.21	1025.32	925.84	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	4317.52	4184.85	3761.52	3256.09	2463.02	1667.66	1014.06	1012.84	1738.22	2631.81	3594.91	4161.04	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	2469.45	1947	1602.35	943.02	391.91	0	0	0	0	990.71	1850.11	2406.99	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 12601.54 (98)

Space heating requirement in kWh/m²/year 65.67 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0.1 (201)

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Fraction of space heat from main system(s)	(202) = 1 – (201) =	0.9	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	0.9	(204)
Efficiency of main space heating system 1		78.9	(206)
Efficiency of secondary/supplementary heating system, %		100	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	2469.45	1947	1602.35	943.02	391.91	0	0	0	0	990.71	1850.11	2406.99		
(211)m = {[(98)m x (204)]} x 100 ÷ (206)	2816.87	2220.91	1827.78	1075.69	447.05	0	0	0	0	1130.08	2110.39	2745.61		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													14374.38	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	246.95	194.7	160.24	94.3	39.19	0	0	0	0	99.07	185.01	240.7		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													1260.15	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	277.49	245.45	259.83	235.76	233.1	211.25	205.7	221.83	220.22	244.33	254.78	271.77		
Efficiency of water heater													68.8	(216)
(217)m=	77.64	77.5	77.17	76.46	74.55	68.8	68.8	68.8	68.8	76.48	77.39	77.63		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	357.43	316.7	336.69	308.35	312.7	307.05	298.98	322.43	320.09	319.45	329.21	350.09		
Total = Sum(219a)$_{1...12}$ =													3879.16	(219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			14374.38	
Space heating fuel used, secondary			1260.15	
Water heating fuel used			3879.16	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			972.31	(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	0.194	=	2788.63	(261)
Space heating (secondary)	(215)	x	0.422	=	531.79	(263)
Water heating	(219)	x	0.194	=	752.56	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4072.97	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.422	=	73.85	(267)

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Electricity for lighting	(232) x	0.422	=	410.31	(268)
Total CO2, kg/year		sum of (265)…(271) =		4557.14	(272)

TER =	24.92	(273)