

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Adrian Fell	Assessor number	3536
Client		Last modified	23/05/2019
Address	B5-A-11-02 West Cromwell Road, Kensington, London, W14 8		

### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )		Average storey height (m)		Volume (m <sup>3</sup> )
Lowest occupied	51.00 (1a)	x	2.55 (2a)	=	130.05 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 51.00 (4)				
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) = 130.05 (5)				

### 2. Ventilation rate

			m <sup>3</sup> per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	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, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 0	÷ (5) =	0.00 (8)

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

Air permeability value, q <sub>50</sub> , expressed in cubic metres per hour per square metre of envelope area	3.00 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15 (18)
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Number of sides on which the dwelling is sheltered	3 (19)
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Shelter factor	1 - [0.075 x (19)] = 0.78 (20)
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Infiltration rate incorporating shelter factor	(18) x (20) = 0.12 (21)
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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 U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50 (23a)
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If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90 (23c)
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a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24
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### 3. Heat losses and heat loss parameter

Element	Gross area, m <sup>2</sup>	Openings m <sup>2</sup>	Net area A, m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	κ-value, kJ/m <sup>2</sup> .K	A x κ, kJ/K						
Window			7.52	1.15	8.61		(27)						
External wall			9.77	0.15	1.47		(29a)						
Party wall			57.63	0.00	0.00		(32)						
Roof			10.17	0.12	1.22		(30)						
Total area of external elements ΣA, m <sup>2</sup>			27.46				(31)						
Fabric heat loss, W/K = Σ(A × U)					(26)...(30) + (32) =	11.30	(33)						
Heat capacity Cm = Σ(A × κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m <sup>2</sup> K						250.00	(35)						
Thermal bridges: Σ(L × Ψ) calculated using Appendix K						4.12	(36)						
Total fabric heat loss					(33) + (36) =	15.42	(37)						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 × (25)m × (5)	10.67	10.55	10.42	9.80	9.68	9.05	9.05	8.93	9.30	9.68	9.93	10.18	(38)
Heat transfer coefficient, W/K (37)m + (38)m	26.09	25.96	25.84	25.22	25.09	24.47	24.47	24.34	24.72	25.09	25.34	25.59	
	Average = Σ(39)1...12/12 =											25.19	(39)
Heat loss parameter (HLP), W/m <sup>2</sup> K (39)m ÷ (4)	0.51	0.51	0.51	0.49	0.49	0.48	0.48	0.48	0.48	0.49	0.50	0.50	
	Average = Σ(40)1...12/12 =											0.49	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

### 4. Water heating energy requirement

Assumed occupancy, N	<div>1.72</div>											(42)	
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$	<div>75.04</div>											(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)													
	82.54	79.54	76.54	73.54	70.54	67.54	67.54	70.54	73.54	76.54	79.54	82.54	
	<div><math>\Sigma(44)1...12 =</math></div>											900.48	(44)
Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)													
	122.41	107.06	110.48	96.32	92.42	79.75	73.90	84.80	85.81	100.01	109.17	118.55	
	<div><math>\Sigma(45)1...12 =</math></div>											1180.67	(45)
Distribution loss $0.15 \times (45)m$													
	18.36	16.06	16.57	14.45	13.86	11.96	11.08	12.72	12.87	15.00	16.37	17.78	(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel												4.00	(47)
Water storage loss:													
b) Manufacturer's declared loss factor is not known													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.02	(51)
Volume factor from Table 2a												3.11	(52)
Temperature factor from Table 2b												1.00	(53)
Energy lost from water storage (kWh/day) $(47) \times (51) \times (52) \times (53)$												0.30	(54)
Enter (50) or (54) in (55)												0.30	(55)
Water storage loss calculated for each month $(55) \times (41)m$													
	9.23	8.34	9.23	8.94	9.23	8.94	9.23	9.23	8.94	9.23	8.94	9.23	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS $(56)m \times [(47) - V_s] \div (47)$ , else (56)													

9.23	8.34	9.23	8.94	9.23	8.94	9.23	9.23	8.94	9.23	8.94	9.23	(57)
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Primary circuit loss for each month from Table 3

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 for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
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Total heat required for water heating calculated for each month  $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

154.91	136.41	142.97	127.76	124.91	111.20	106.40	117.30	117.26	132.50	140.61	151.04	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

154.91	136.41	142.97	127.76	124.91	111.20	106.40	117.30	117.26	132.50	140.61	151.04	
$\Sigma(64)1...12 =$											1563.29	(64)

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

66.70	59.08	62.73	57.18	56.73	51.68	50.57	54.19	53.69	59.25	61.46	65.41	(65)
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## 5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Metabolic gains (Table 5)

85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	85.98	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

13.80	12.26	9.97	7.55	5.64	4.76	5.15	6.69	8.98	11.40	13.30	14.18	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

149.83	151.39	147.47	139.13	128.60	118.70	112.09	110.54	114.45	122.80	133.32	143.22	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	31.60	(69)
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Pump and fan gains (Table 5a)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
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Losses e.g. evaporation (Table 5)

-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
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Water heating gains (Table 5)

89.65	87.91	84.32	79.42	76.24	71.77	67.97	72.84	74.57	79.64	85.36	87.92	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

302.07	300.35	290.54	274.89	259.28	244.03	234.00	238.86	246.80	262.62	280.78	294.12	(73)
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## 6. Solar gains

	Access factor Table 6d	Area m <sup>2</sup>	Solar flux W/m <sup>2</sup>	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
SouthWest	0.77	x 4.70	x 36.79	x 0.9	x 0.50	x 0.80	= 47.94 (79)
NorthEast	0.77	x 2.82	x 11.28	x 0.9	x 0.50	x 0.80	= 8.82 (75)

Solar gains in watts  $\Sigma(74)m...(82)m$

56.76	99.61	144.07	191.55	226.46	230.06	219.62	192.78	160.39	112.18	68.51	48.23	(83)
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Total gains - internal and solar (73)m + (83)m

358.83	399.96	434.61	466.44	485.73	474.09	453.62	431.64	407.18	374.81	349.29	342.34	(84)
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## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains for living area n1,m (see Table 9a)

0.97	0.93	0.83	0.65	0.48	0.33	0.24	0.26	0.42	0.69	0.92	0.98	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.82	20.90	20.97	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.93	20.80	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.51	20.51	20.51	20.53	20.53	20.54	20.54	20.54	20.53	20.53	20.52	20.52	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.97	0.92	0.81	0.63	0.46	0.31	0.21	0.23	0.39	0.66	0.90	0.97	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.28	20.39	20.48	20.52	20.53	20.54	20.54	20.54	20.53	20.52	20.44	20.26	(90)
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Living area fraction

Living area ÷ (4) = 0.46 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.53	20.63	20.71	20.74	20.75	20.75	20.75	20.75	20.75	20.74	20.67	20.51	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.53	20.63	20.71	20.74	20.75	20.75	20.75	20.75	20.75	20.74	20.67	20.51	(93)
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## 8. Space heating requirement

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

Utilisation factor for gains, ηm

0.97	0.92	0.82	0.64	0.47	0.32	0.22	0.25	0.40	0.68	0.90	0.97	(94)
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Useful gains, ηmGm, W (94)m x (84)m

346.46	367.57	354.95	297.54	226.92	150.52	101.58	105.96	164.35	253.01	315.87	333.25	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

423.34	408.38	367.10	298.61	226.97	150.52	101.58	105.96	164.35	254.48	343.85	417.39	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

57.20	27.42	9.04	0.77	0.03	0.00	0.00	0.00	0.00	1.09	20.15	62.60	
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Σ(98)1...5, 10...12 = 178.31 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 3.50 (99)

## 9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)

'0' if none 0.00 (301)

Fraction of space heat from community system

1 - (301) = 1.00 (302)

Fraction of community heat from boilers

0.29 (303a)

Fraction of community heat from heat pump

0.71 (303b)

Fraction of total space heat from community boilers

(302) x (303a) = 0.29 (304a)

Fraction of total space heat from community heat pump

(302) x (303b) = 0.71 (304b)

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

1.00 (305)

Factor for charging method (Table 4c(3)) for community water heating

1.00 (305a)

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

1.05 (306)

## Space heating

Annual space heating requirement

178.31 (98)

Space heat from boilers

(98) x (304a) x (305) x (306) = 54.29 (307a)

Space heat from heat pump

(98) x (304b) x (305) x (306) = 132.93 (307b)

## Water heating

Annual water heating requirement

1563.29 (64)

Water heat from boilers	$(64) \times (303a) \times (305a) \times (306) =$	476.02	(310a)
Water heat from heat pump	$(64) \times (303b) \times (305a) \times (306) =$	1165.43	(310b)
Electricity used for heat distribution	$0.01 \times [(307a)...(307e) + (310a)...(310e)] =$	18.29	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside		122.96	(330a)
Total electricity for the above, kWh/year		122.96	(331)
Electricity for lighting (Appendix L)		243.69	(332)
Total delivered energy for all uses	$(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =$	2195.32	(338)

#### 10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	54.29	x	4.24	x 0.01 =	2.30	(340a)
Space heating from heat pump	132.93	x	4.24	x 0.01 =	5.64	(340b)
Water heating from boilers	476.02	x	4.24	x 0.01 =	20.18	(342a)
Water heating from heat pump	1165.43	x	4.24	x 0.01 =	49.41	(342b)
Pumps and fans	122.96	x	13.19	x 0.01 =	16.22	(349)
Electricity for lighting	243.69	x	13.19	x 0.01 =	32.14	(350)
Additional standing charges					120.00	(351)
Total energy cost				$(340a)...(342e) + (345)...(354) =$	245.90	(355)

#### 11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.08	(357)
SAP value	84.99	
SAP rating (section 13)	85	(358)
SAP band	B	

#### 12b. CO<sub>2</sub> emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	93.19					(367a)
CO <sub>2</sub> emissions from boilers	$[(307a)+(310a)] \times 100 \div (367a) =$	569.07	x	0.216	=	122.92 (367)
Efficiency of heat pump	333.00					(367b)
CO <sub>2</sub> emissions from heat pump	$[(307b)+(310b)] \times 100 \div (367b) =$	389.90	x	0.519	=	202.36 (368)
Electrical energy for community heat distribution	18.29	x	0.519	=	9.49	(372)
Total CO <sub>2</sub> associated with community systems					334.77	(373)
Total CO <sub>2</sub> associated with space and water heating					334.77	(376)
Pumps and fans	122.96	x	0.519	=	63.82	(378)
Electricity for lighting	243.69	x	0.519	=	126.47	(379)
Total CO <sub>2</sub> , kg/year				$(376)...(382) =$	525.06	(383)
Dwelling CO <sub>2</sub> emission rate				$(383) \div (4) =$	10.30	(384)
EI value					92.67	
EI rating (section 14)					93	(385)
EI band					A	

#### 13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)
Primary energy from other sources (space heating)					
Efficiency of boilers	93.19				(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	569.07	x	1.22	= 694.26 (367)
Efficiency of heat pump	333.00				(367b)
Primary energy from heat pump	[(307b)+(310b)] x 100 ÷ (367b) =	389.90	x	3.07	= 1196.98 (368)
Electrical energy for community heat distribution	18.29		x	3.07	= 56.14 (372)
Total primary energy associated with community systems					1947.39 (373)
Total primary energy associated with space and water heating					1947.39 (376)
Pumps and fans	122.96		x	3.07	= 377.49 (378)
Electricity for lighting	243.69		x	3.07	= 748.12 (379)
Primary energy kWh/year					3073.00 (383)
Dwelling primary energy rate kWh/m2/year					60.25 (384)