DER Worksheet
Design - Draft

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 Will Belfield	Assessor number	129
Client		Last modified	05/11/2019
Address	Manor Road Richmond Block E, Richmond, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		62.40	(1a) x	2.65	(2a) =	165.36	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	62.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	165.36	(5)

2. Ventilation rate

			m³ 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, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(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 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	(22)
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	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	76.50	(23c)

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

	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.25	0.25	0.26	0.27	(24a)

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

	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.25	0.25	0.26	0.27	(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	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.13	x	1.33	=	17.41			(27)
External wall			31.82	x	0.15	=	4.77			(29a)
External wall			2.32	x	0.01	=	0.02			(29a)
Party wall			45.53	x	0.00	=	0.00			(32)
Roof			62.40	x	0.16	=	9.98			(30)
Total area of external elements ∑A, m²			109.67							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.19 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		100.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		10.11 (36)
Total fabric heat loss	(33) + (36) =	42.30 (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.28	15.11	14.93	14.07	13.89	13.02	13.02	12.85	13.37	13.89	14.24	14.59	(38)

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

57.58	57.41	57.23	56.36	56.19	55.32	55.32	55.15	55.67	56.19	56.54	56.89	

Average = ∑(39)1...12/12 = 56.32 (39)

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

0.92	0.92	0.92	0.90	0.90	0.89	0.89	0.88	0.89	0.90	0.91	0.91	

Average = ∑(40)1...12/12 = 0.90 (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	2.05 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	82.85 (43)

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	
91.14	87.83	84.51	81.20	77.88	74.57	74.57	77.88	81.20	84.51	87.83	91.14	

∑(44)1...12 = 994.26 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

135.16	118.21	121.98	106.35	102.04	88.05	81.60	93.63	94.75	110.42	120.54	130.89	

∑(45)1...12 = 1303.63 (45)

Distribution loss 0.15 x (45)m

20.27	17.73	18.30	15.95	15.31	13.21	12.24	14.04	14.21	16.56	18.08	19.63	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	194.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	1.61 (48)
Temperature factor from Table 2b	0.60 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.97 (50)
Enter (50) or (54) in (55)	0.97 (55)

Water storage loss calculated for each month (55) x (41)m

29.95	27.05	29.95	28.98	29.95	28.98	29.95	29.95	28.98	29.95	28.98	29.95	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

29.95	27.05	29.95	28.98	29.95	28.98	29.95	29.95	28.98	29.95	28.98	29.95	(57)

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)

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)

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

188.37	166.27	175.19	157.84	155.25	139.55	134.80	146.84	146.24	163.63	172.03	184.10	(62)

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)

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

188.37	166.27	175.19	157.84	155.25	139.55	134.80	146.84	146.24	163.63	172.03	184.10	

∑(64)1...12 = 1930.11 (64)

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

87.51	77.75	83.13	76.55	76.50	70.47	69.70	73.70	72.70	79.28	81.27	86.09	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	102.43	102.43	102.43	102.43	102.43	102.43	102.43	102.43	102.43	102.43	102.43	102.43	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.95	14.17	11.52	8.72	6.52	5.51	5.95	7.73	10.38	13.18	15.38	16.40	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	178.96	180.81	176.13	166.17	153.60	141.78	133.88	132.02	136.70	146.67	159.24	171.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.24	33.24	33.24	33.24	33.24	33.24	33.24	33.24	33.24	33.24	33.24	33.24	(69)
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)
Losses e.g. evaporation (Table 5)	-81.94	-81.94	-81.94	-81.94	-81.94	-81.94	-81.94	-81.94	-81.94	-81.94	-81.94	-81.94	(71)
Water heating gains (Table 5)	117.62	115.70	111.73	106.33	102.82	97.88	93.68	99.06	100.97	106.56	112.88	115.71	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	366.26	364.42	353.12	334.95	316.66	298.89	287.24	292.54	301.78	320.14	341.23	356.90	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	6.83	x	11.28	x 0.9 x	0.40	x	0.90	=	19.23	(81)
NorthEast	0.77	x	3.15	x	11.28	x 0.9 x	0.40	x	0.90	=	8.87	(75)
East	0.77	x	3.15	x	19.64	x 0.9 x	0.40	x	0.90	=	15.43	(76)

Solar gains in watts ∑(74)m...(82)m

43.53	87.38	152.75	241.72	316.31	333.45	313.44	255.23	183.37	105.71	54.59	35.63	(83)

Total gains - internal and solar (73)m + (83)m

409.78	451.79	505.86	576.67	632.97	632.34	600.68	547.77	485.15	425.84	395.82	392.53	(84)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.95	0.94	0.90	0.81	0.68	0.51	0.39	0.44	0.66	0.86	0.93	0.96

(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.23	19.44	19.83	20.33	20.71	20.91	20.97	20.96	20.80	20.31	19.70	19.19

(87)

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

20.15	20.15	20.15	20.16	20.17	20.18	20.18	20.18	20.17	20.17	20.16	20.16

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.95	0.93	0.89	0.79	0.64	0.46	0.32	0.37	0.61	0.83	0.92	0.95

(89)

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

17.76	18.07	18.63	19.34	19.84	20.09	20.16	20.15	19.97	19.33	18.46	17.72

(90)

Living area fraction — Living area ÷ (4) = 0.55 (91)

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

18.57	18.83	19.29	19.89	20.32	20.54	20.61	20.60	20.43	19.87	19.14	18.53

(92)

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

18.57	18.83	19.29	19.89	20.32	20.54	20.61	20.60	20.43	19.87	19.14	18.53

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.93	0.91	0.87	0.78	0.65	0.48	0.36	0.40	0.62	0.82	0.91	0.94	(94)
Useful gains, ηmGm, W (94)m x (84)m	382.76	412.64	439.68	449.33	408.44	306.34	215.11	221.84	302.82	350.68	360.03	369.10	(95)
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)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	821.69	799.58	732.16	619.17	484.12	328.83	221.65	231.40	352.31	520.94	680.77	815.26	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	326.57	260.02	217.61	122.28	56.30	0.00	0.00	0.00	0.00	126.67	230.94	331.94	

∑(98)1...5, 10...12 = 1672.33 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 26.80 (99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm	0.00	0.00	0.00	0.00	0.00	520.01	409.37	419.11	0.00	0.00	0.00	0.00	(100)
Utilisation factor for loss ηm	0.00	0.00	0.00	0.00	0.00	0.89	0.93	0.91	0.00	0.00	0.00	0.00	(101)
Useful loss ηmLm (watts) (100)m x (101)m	0.00	0.00	0.00	0.00	0.00	462.42	379.47	380.44	0.00	0.00	0.00	0.00	(102)
Gains	0.00	0.00	0.00	0.00	0.00	803.31	765.05	704.07	0.00	0.00	0.00	0.00	(103)
Space cooling requirement, whole dwelling, continuous (kWh) 0.024 x [(103)m - (102)m] x (41)m	0.00	0.00	0.00	0.00	0.00	245.44	286.87	240.78	0.00	0.00	0.00	0.00	

∑(104)6...8 = 773.09 (104)

Cooled fraction — cooled area ÷ (4) = 0.55 (105)

Intermittency factor (Table 10)

0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.00

∑(106)6...8 = 0.75 (106)

Space cooling requirement (104)m x (105) x (106)m

0.00	0.00	0.00	0.00	0.00	33.83	39.54	33.18	0.00	0.00	0.00	0.00

	∑(107)6...8 =	106.55	(107)
Space cooling requirement kWh/m²/year	(107) ÷ (4) =	1.71	(108)

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 heat pump		1.00	(303a)
Fraction of total space heat from community heat pump	(302) x (303a) =	1.00	(304a)
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		1.07	(306)

Space heating

Annual space heating requirement	1672.33		(98)
Space heat from heat pump	(98) x (304a) x (305) x (306) =	1789.40	(307a)

Water heating

Annual water heating requirement	1930.11		(64)
Water heat from heat pump	(64) x (303a) x (305a) x (306) =	2065.22	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	38.55	(313)

Cooling System Energy Efficiency Ratio		4.05	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	(107) ÷ (314)	26.31	(315)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	155.34		(330a)
Total electricity for the above, kWh/year		155.34	(331)
Electricity for lighting (Appendix L)		281.75	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4318.02	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from heat pump	1789.40	x	4.24	x 0.01 =	75.87	(340a)
Water heating from heat pump	2065.22	x	4.24	x 0.01 =	87.57	(342a)
Space cooling	26.31	x	13.19	x 0.01 =	3.47	(348)
Pumps and fans	155.34	x	13.19	x 0.01 =	20.49	(349)
Electricity for lighting	281.75	x	13.19	x 0.01 =	37.16	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		344.56	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.35	(357)
SAP value	81.20	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of heat pump	180.00					(367a)
CO2 emissions from heat pump [(307a)+(310a)] x 100 ÷ (367a) =	2141.45	x	0.519	=	1111.41	(367)
Electrical energy for community heat distribution	38.55	x	0.519	=	20.01	(372)
Total CO2 associated with community systems					1131.42	(373)
Total CO2 associated with space and water heating					1131.42	(376)
Space cooling	26.31	x	0.519	=	13.65	(377)
Pumps and fans	155.34	x	0.519	=	80.62	(378)
Electricity for lighting	281.75	x	0.519	=	146.23	(379)
Total CO_2, kg/year				(376)..(382) =	1371.93	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	21.99	(384)
EI value					82.88	
EI rating (section 14)					83	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of heat pump	180.00					(367a)
Primary energy from heat pump [(307a)+(310a)] x 100 ÷ (367a) =	2141.45	x	3.07	=	6574.26	(367)
Electrical energy for community heat distribution	38.55	x	3.07	=	118.34	(372)
Total primary energy associated with community systems					6692.60	(373)
Total primary energy associated with space and water heating					6692.60	(376)
Space cooling	26.31	x	3.07	=	80.77	(377)
Pumps and fans	155.34	x	3.07	=	476.89	(378)
Electricity for lighting	281.75	x	3.07	=	864.99	(379)
Primary energy kWh/year					8115.24	(383)
Dwelling primary energy rate kWh/m2/year					130.05	(384)