Appendix H: SAP worksheets.

Be Lean example data sheet – DER & TER

DER Worksheet
Design - Draft

NHER

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	Miss Michelle Wang	Assessor number	2018
Client		Last modified	04/02/2019
Address	Manor Road Richmond Block 1, Richmond, TW9		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		101.94	(1a)	x	2.63	(2a)	=	268.10	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	101.94	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	268.10	(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)

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

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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			28.36	x	1.33	=	37.60			(27)
External wall			48.72	x	0.15	=	7.31			(29a)
External wall			8.64	x	0.01	=	0.09			(29a)
Party wall			31.96	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			85.72							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	44.99	(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		16.29	(36)
Total fabric heat loss	(33) + (36) =	61.29	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	24.78	24.50	24.21	22.80	22.52	21.11	21.11	20.83	21.68	22.52	23.09	23.65	(38)
Heat transfer coefficient, W/K (37)m + (38)m	86.07	85.78	85.50	84.09	83.81	82.40	82.40	82.12	82.96	83.81	84.37	84.94	
Average = ∑(39)1...12/12 =												84.02	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.84	0.84	0.84	0.82	0.82	0.81	0.81	0.81	0.81	0.82	0.83	0.83	
Average = ∑(40)1...12/12 =												0.82	(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	2.76	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.67	(43)

	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)	109.64	105.65	101.67	97.68	93.69	89.71	89.71	93.69	97.68	101.67	105.65	109.64	
∑(44)1...12 =												1196.08	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	162.59	142.21	146.74	127.93	122.76	105.93	98.16	112.64	113.98	132.84	145.00	157.46	
∑(45)1...12 =												1568.25	(45)
Distribution loss 0.15 x (45)m	24.39	21.33	22.01	19.19	18.41	15.89	14.72	16.90	17.10	19.93	21.75	23.62	(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)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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	215.80	190.26	199.95	179.43	175.96	157.42	151.37	165.85	165.48	186.05	196.49	210.67	(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	215.80	190.26	199.95	179.43	175.96	157.42	151.37	165.85	165.48	186.05	196.49	210.67	
∑(64)1...12 =												2194.74	(64)
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	96.63	85.73	91.36	83.73	83.38	76.42	75.20	80.02	79.09	86.74	89.41	94.92	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.13	20.54	16.71	12.65	9.45	7.98	8.62	11.21	15.05	19.10	22.30	23.77	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	259.43	262.12	255.33	240.89	222.66	205.53	194.08	191.39	198.17	212.62	230.85	247.98	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	(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)	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	(71)
Water heating gains (Table 5)	129.88	127.58	122.79	116.29	112.07	106.13	101.08	107.55	109.85	116.58	124.18	127.59	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	476.78	474.59	459.19	434.19	408.54	383.99	368.14	374.50	387.42	412.65	441.67	463.69	(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	
SouthEast	0.77	x	7.88	x	36.79	x 0.9 x	0.40	x	0.65	=	52.24	(77)
SouthWest	0.77	x	8.40	x	36.79	x 0.9 x	0.40	x	0.65	=	55.69	(79)
NorthWest	0.77	x	12.08	x	11.28	x 0.9 x	0.40	x	0.65	=	24.56	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	132.49	233.83	341.60	459.58	547.92	558.54	532.42	464.29	382.11	264.28	160.17	112.42	(83)
Total gains - internal and solar (73)m + (83)m	609.27	708.42	800.79	893.77	956.46	942.53	900.56	838.79	769.53	676.93	601.85	576.11	(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)	0.96	0.94	0.90	0.81	0.68	0.52	0.39	0.43	0.64	0.85	0.94	0.97	(86)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.33	19.59	19.97	20.42	20.75	20.93	20.98	20.97	20.85	20.42	19.80	19.29	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	20.22	20.22	20.22	20.23	20.23	20.25	20.25	20.25	20.24	20.23	20.23	20.22	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.96	0.93	0.88	0.79	0.64	0.47	0.33	0.37	0.59	0.83	0.93	0.96	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	17.96	18.34	18.88	19.51	19.95	20.18	20.23	20.23	20.08	19.52	18.65	17.90	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	18.58	18.91	19.38	19.93	20.31	20.52	20.57	20.57	20.43	19.93	19.18	18.53	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.58	18.91	19.38	19.93	20.31	20.52	20.57	20.57	20.43	19.93	19.18	18.53	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.94	0.92	0.87	0.78	0.65	0.49	0.36	0.39	0.61	0.82	0.92	0.95	(94)
Useful gains, ηmGm, W (94)m x (84)m	574.80	648.34	694.31	695.67	620.29	459.07	319.75	331.32	466.03	552.82	551.65	547.68	(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]	1229.43	1201.98	1101.29	927.45	721.90	487.67	327.30	342.05	525.40	781.79	1018.89	1217.51	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	487.04	372.05	302.80	166.88	75.60	0.00	0.00	0.00	0.00	170.35	336.42	498.35	

∑(98)1...5, 10...12 = 2409.49 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 23.64 (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	774.55	609.76	624.09	0.00	0.00	0.00	0.00	(100)
Utilisation factor for loss ηm	0.00	0.00	0.00	0.00	0.00	0.90	0.94	0.92	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	697.11	571.27	575.72	0.00	0.00	0.00	0.00	(102)
Gains	0.00	0.00	0.00	0.00	0.00	1195.11	1144.06	1073.34	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	358.56	426.16	370.23	0.00	0.00	0.00	0.00	

∑(104)6...8 = 1154.95 (104)

Cooled fraction — cooled area ÷ (4) = 0.46 (105)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space cooling requirement (104)m x (105) x (106)m	0.00	0.00	0.00	0.00	0.00	40.98	48.70	42.31	0.00	0.00	0.00	0.00

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	∑(107)6...8 =	131.99	(107)
Space cooling requirement kWh/m²/year	(107) ÷ (4) =	1.29	(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 boilers			1.00	(303a)
Fraction of total space heat from community boilers		(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			1.05	(306)
Space heating				
Annual space heating requirement	2409.49			(98)
Space heat from boilers		(98) x (304a) x (305) x (306) =	2529.96	(307a)
Water heating				
Annual water heating requirement	2194.74			(64)
Water heat from boilers		(64) x (303a) x (305a) x (306) =	2304.47	(310a)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	48.34	(313)
Cooling System Energy Efficiency Ratio			4.05	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)		(107) ÷ (314)	32.59	(315)
Electricity for pumps, fans and electric keep-hot (Table 4f)				
mechanical ventilation fans - balanced, extract or positive input from outside	251.86			(330a)
Total electricity for the above, kWh/year			251.86	(331)
Electricity for lighting (Appendix L)			408.45	(332)
Total delivered energy for all uses		(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5527.33	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	2529.96	x	4.24	x 0.01 =	107.27	(340a)
Water heating from boilers	2304.47	x	4.24	x 0.01 =	97.71	(342a)
Space cooling	32.59	x	13.19	x 0.01 =	4.30	(348)
Pumps and fans	251.86	x	13.19	x 0.01 =	33.22	(349)
Electricity for lighting	408.45	x	13.19	x 0.01 =	53.87	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	416.37	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.19	(357)
SAP value	83.40	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year	Emission factor	Emissions (kg/year)

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Emissions from other sources (space heating)							
Efficiency of boilers		89.50					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	5401.60	x	0.216	=	1166.75	(367)
Electrical energy for community heat distribution		48.34	x	0.519	=	25.09	(372)
Total CO2 associated with community systems						1191.84	(373)
Total CO2 associated with space and water heating						1191.84	(376)
Space cooling		32.59	x	0.519	=	16.91	(377)
Pumps and fans		251.86	x	0.519	=	130.71	(378)
Electricity for lighting		408.45	x	0.519	=	211.98	(379)
Total CO_2, kg/year					(376)...(382) =	1551.45	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	15.22	(384)
EI value						85.85	
EI rating (section 14)						86	(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 boilers		89.50					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	5401.60	x	1.22	=	6589.96	(367)
Electrical energy for community heat distribution		48.34	x	3.07	=	148.42	(372)
Total primary energy associated with community systems						6738.38	(373)
Total primary energy associated with space and water heating						6738.38	(376)
Space cooling		32.59	x	3.07	=	100.05	(377)
Pumps and fans		251.86	x	3.07	=	773.20	(378)
Electricity for lighting		408.45	x	3.07	=	1253.94	(379)
Primary energy kWh/year						8865.56	(383)
Dwelling primary energy rate kWh/m2/year						86.97	(384)

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TER Worksheet
Design - Draft

NHER

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	Miss Michelle Wang	Assessor number	2018
Client		Last modified	04/02/2019
Address	Manor Road Richmond Block 1, Richmond, TW9		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		101.94	(1a)	x	2.63	(2a)	=	268.10	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	101.94	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			268.10	(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	4	x 10 =	40	(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) =	40	÷ (5) =	0.15	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.40	(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) =	0.34	(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	0.43	0.42	0.42	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.40	(22b)

Calculate effective air change rate for the applicable case:

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	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	κ-value, kJ/m².K	A x κ, kJ/K	
Window			25.50	x	1.33	=	33.81			(27)
External wall			60.22	x	0.18	=	10.84			(29a)
Party wall			31.96	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			85.72							(31)

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) =	44.65	(33)
Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K	250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K	6.93	(36)
Total fabric heat loss (33) + (36) =	51.58	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	52.52	52.20	51.88	50.40	50.12	48.83	48.83	48.59	49.33	50.12	50.68	51.27	(38)
Heat transfer coefficient, W/K (37)m + (38)m	104.09	103.77	103.46	101.98	101.70	100.41	100.41	100.17	100.91	101.70	102.26	102.85	
Average = ∑(39)1...12/12 =												101.98	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.02	1.02	1.01	1.00	1.00	0.99	0.99	0.98	0.99	1.00	1.00	1.01	
Average = ∑(40)1...12/12 =												1.00	(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	2.76	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.67	(43)

	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)	109.64	105.65	101.67	97.68	93.69	89.71	89.71	93.69	97.68	101.67	105.65	109.64	
∑(44)1...12 =												1196.08	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	162.59	142.21	146.74	127.93	122.76	105.93	98.16	112.64	113.98	132.84	145.00	157.46	
∑(45)1...12 =												1568.25	(45)
Distribution loss 0.15 x (45)m	24.39	21.33	22.01	19.19	18.41	15.89	14.72	16.90	17.10	19.93	21.75	23.62	(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)	1.62	(48)
Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.88	(50)
Enter (50) or (54) in (55)	0.88	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	27.16	24.54	27.16	26.29	27.16	26.29	27.16	27.16	26.29	27.16	26.29	27.16	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	27.16	24.54	27.16	26.29	27.16	26.29	27.16	27.16	26.29	27.16	26.29	27.16	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	213.02	187.75	197.17	176.74	173.18	154.73	148.59	163.07	162.78	183.26	193.80	207.89	(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	213.02	187.75	197.17	176.74	173.18	154.73	148.59	163.07	162.78	183.26	193.80	207.89	
∑(64)1...12 =												2161.99	(64)
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	94.40	83.72	89.13	81.58	81.16	74.26	72.98	77.79	76.94	84.51	87.25	92.70	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.13	20.54	16.71	12.65	9.45	7.98	8.62	11.21	15.05	19.10	22.30	23.77	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	259.43	262.12	255.33	240.89	222.66	205.53	194.08	191.39	198.17	212.62	230.85	247.98	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	(71)
Water heating gains (Table 5)	126.89	124.59	119.80	113.30	109.08	103.14	98.09	104.56	106.86	113.59	121.19	124.59	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	476.79	474.60	459.20	434.20	408.55	384.00	368.15	374.51	387.43	412.66	441.68	463.70	(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	
SouthEast	0.77	x	7.09	x	36.79	x 0.9 x	0.63	x	0.70	=	79.72	(77)
SouthWest	0.77	x	7.55	x	36.79	x 0.9 x	0.63	x	0.70	=	84.90	(79)
NorthWest	0.77	x	10.86	x	11.28	x 0.9 x	0.63	x	0.70	=	37.45	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	202.07	356.64	521.01	700.93	835.65	851.84	812.01	708.11	582.78	403.07	244.30	171.46	(83)
Total gains - internal and solar (73)m + (83)m	678.86	831.24	980.20	1135.13	1244.20	1235.84	1180.16	1082.62	970.21	815.73	685.98	635.16	(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)	1.00	0.99	0.97	0.88	0.71	0.51	0.37	0.42	0.68	0.94	0.99	1.00	(86)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	20.00	20.20	20.48	20.78	20.95	20.99	21.00	21.00	20.97	20.72	20.30	19.97	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	20.07	20.07	20.07	20.08	20.09	20.10	20.10	20.10	20.09	20.09	20.08	20.08	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.95	0.85	0.66	0.44	0.30	0.34	0.61	0.91	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.73	19.03	19.42	19.84	20.04	20.09	20.10	20.10	20.07	19.78	19.18	18.69	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.31	19.56	19.90	20.27	20.45	20.50	20.51	20.51	20.48	20.21	19.69	19.27	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.31	19.56	19.90	20.27	20.45	20.50	20.51	20.51	20.48	20.21	19.69	19.27	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.95	0.86	0.68	0.48	0.33	0.38	0.64	0.91	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	675.04	817.80	933.72	973.93	847.16	588.07	391.97	410.58	621.24	746.07	676.49	632.59	(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]	1562.54	1521.51	1386.84	1159.51	890.12	592.78	392.46	411.60	643.81	977.22	1287.58	1550.29	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	660.30	472.90	337.12	133.61	31.96	0.00	0.00	0.00	0.00	171.97	439.98	682.77	

	∑(98)1...5, 10...12 =	2930.61	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)	28.75	(99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.50	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	706.20	505.77	360.56	142.90	34.18	0.00	0.00	0.00	0.00	183.93	470.57	730.23	

∑(211)1...5, 10...12 = 3134.34 (211)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of water heater	87.63	87.18	86.23	84.08	81.30	79.80	79.80	79.80	79.80	84.64	86.94	87.75	(217)
Water heating fuel, kWh/month	243.08	215.37	228.65	210.20	213.02	193.90	186.20	204.34	203.99	216.51	222.93	236.90	

∑(219a)1...12 = 2575.09 (219)

Annual totals

Space heating fuel - main system 1 — 3134.34

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Water heating fuel		2575.09	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		408.45	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6192.89	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3134.34	x	3.48	x 0.01 =	109.08	(240)
Water heating	2575.09	x	3.48	x 0.01 =	89.61	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	408.45	x	13.19	x 0.01 =	53.87	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	382.46	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.09	(257)
SAP value	84.75	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3134.34	x	0.216	=	677.02	(261)
Water heating	2575.09	x	0.216	=	556.22	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1233.24	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	408.45	x	0.519	=	211.98	(268)
Total CO_2, kg/year				(265)...(271) =	1484.15	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	14.56	(273)
EI value					86.47	
EI rating (section 14)					86	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3134.34	x	1.22	=	3823.90	(261)
Water heating	2575.09	x	1.22	=	3141.61	(264)
Space and water heating				(261) + (262) + (263) + (264) =	6965.51	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	408.45	x	3.07	=	1253.94	(268)
Primary energy kWh/year					8449.70	(272)
Dwelling primary energy rate kWh/m2/year					82.89	(273)

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Be Green example data sheet – DER & TER

DER Worksheet
Design - Draft

NHER

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	Miss Michelle Wang	Assessor number	2018
Client		Last modified	04/02/2019
Address	Manor Road Richmond Block 1, Richmond, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		101.94	(1a) x	2.63	(2a) =	268.10	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	101.94	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	268.10	(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)

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

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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			28.36	x	1.33	=	37.60			(27)
External wall			48.72	x	0.15	=	7.31			(29a)
External wall			8.64	x	0.01	=	0.09			(29a)
Party wall			31.96	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			85.72							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	44.99	(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		16.29	(36)
Total fabric heat loss	(33) + (36) =	61.29	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	24.78	24.50	24.21	22.80	22.52	21.11	21.11	20.83	21.68	22.52	23.09	23.65	(38)
Heat transfer coefficient, W/K (37)m + (38)m	86.07	85.78	85.50	84.09	83.81	82.40	82.40	82.12	82.96	83.81	84.37	84.94	

Average = ∑(39)1...12/12 = 84.02 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.84	0.84	0.84	0.82	0.82	0.81	0.81	0.81	0.81	0.82	0.83	0.83	

Average = ∑(40)1...12/12 = 0.82 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	2.76	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.67	(43)

	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)	109.64	105.65	101.67	97.68	93.69	89.71	89.71	93.69	97.68	101.67	105.65	109.64	

∑(44)1...12 = 1196.08 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	162.59	142.21	146.74	127.93	122.76	105.93	98.16	112.64	113.98	132.84	145.00	157.46	

∑(45)1...12 = 1568.25 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	24.39	21.33	22.01	19.19	18.41	15.89	14.72	16.90	17.10	19.93	21.75	23.62	(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)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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	215.80	190.26	199.95	179.43	175.96	157.42	151.37	165.85	165.48	186.05	196.49	210.67	(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	215.80	190.26	199.95	179.43	175.96	157.42	151.37	165.85	165.48	186.05	196.49	210.67	

∑(64)1...12 = 2194.74 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	96.63	85.73	91.36	83.73	83.38	76.42	75.20	80.02	79.09	86.74	89.41	94.92	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.13	20.54	16.71	12.65	9.45	7.98	8.62	11.21	15.05	19.10	22.30	23.77	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	259.43	262.12	255.33	240.89	222.66	205.53	194.08	191.39	198.17	212.62	230.85	247.98	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	(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)	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	(71)
Water heating gains (Table 5)	129.88	127.58	122.79	116.29	112.07	106.13	101.08	107.55	109.85	116.58	124.18	127.59	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	476.78	474.59	459.19	434.19	408.54	383.99	368.14	374.50	387.42	412.65	441.67	463.69	(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	
SouthEast	0.77	x	7.88	x	36.79	x 0.9 x	0.40	x	0.65	=	52.24	(77)
SouthWest	0.77	x	8.40	x	36.79	x 0.9 x	0.40	x	0.65	=	55.69	(79)
NorthWest	0.77	x	12.08	x	11.28	x 0.9 x	0.40	x	0.65	=	24.56	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	132.49	233.83	341.60	459.58	547.92	558.54	532.42	464.29	382.11	264.28	160.17	112.42	(83)
Total gains - internal and solar (73)m + (83)m	609.27	708.42	800.79	893.77	956.46	942.53	900.56	838.79	769.53	676.93	601.85	576.11	(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)	0.96	0.94	0.90	0.81	0.68	0.52	0.39	0.43	0.64	0.85	0.94	0.97	(86)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.33	19.59	19.97	20.42	20.75	20.93	20.98	20.97	20.85	20.42	19.80	19.29	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	20.22	20.22	20.22	20.23	20.23	20.25	20.25	20.25	20.24	20.23	20.23	20.22	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.96	0.93	0.88	0.79	0.64	0.47	0.33	0.37	0.59	0.83	0.93	0.96	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	17.96	18.34	18.88	19.51	19.95	20.18	20.23	20.23	20.08	19.52	18.65	17.90	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	18.58	18.91	19.38	19.93	20.31	20.52	20.57	20.57	20.43	19.93	19.18	18.53	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.58	18.91	19.38	19.93	20.31	20.52	20.57	20.57	20.43	19.93	19.18	18.53	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.94	0.92	0.87	0.78	0.65	0.49	0.36	0.39	0.61	0.82	0.92	0.95	(94)
Useful gains, ηmGm, W (94)m x (84)m	574.80	648.34	694.31	695.67	620.29	459.07	319.75	331.32	466.03	552.82	551.65	547.68	(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]	1229.43	1201.98	1101.29	927.45	721.90	487.67	327.30	342.05	525.40	781.79	1018.89	1217.51	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	487.04	372.05	302.80	166.88	75.60	0.00	0.00	0.00	0.00	170.35	336.42	498.35	

∑(98)1...5, 10...12 = 2409.49 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 23.64 (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	774.55	609.76	624.09	0.00	0.00	0.00	0.00	(100)
Utilisation factor for loss ηm	0.00	0.00	0.00	0.00	0.00	0.90	0.94	0.92	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	697.11	571.27	575.72	0.00	0.00	0.00	0.00	(102)
Gains	0.00	0.00	0.00	0.00	0.00	1195.11	1144.06	1073.34	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	358.56	426.16	370.23	0.00	0.00	0.00	0.00	

∑(104)6...8 = 1154.95 (104)

Cooled fraction — cooled area ÷ (4) = 0.46 (105)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space cooling requirement (104)m x (105) x (106)m	0.00	0.00	0.00	0.00	0.00	40.98	48.70	42.31	0.00	0.00	0.00	0.00

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	∑(107)6...8 =	131.99	(107)
Space cooling requirement kWh/m²/year	(107) ÷ (4) =	1.29	(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		1.25	(306)

Space heating

Annual space heating requirement	2409.49			(98)
Space heat from heat pump		(98) x (304a) x (305) x (306) =	3011.86	(307a)

Water heating

Annual water heating requirement	2194.74			(64)
Water heat from heat pump		(64) x (303a) x (305a) x (306) =	2743.42	(310a)
Electricity used for heat distribution		0.01 x [(307a)...(307e) + (310a)...(310e)] =	57.55	(313)
Cooling System Energy Efficiency Ratio			4.05	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)		(107) ÷ (314)	32.59	(315)
Electricity for pumps, fans and electric keep-hot (Table 4f)				
mechanical ventilation fans - balanced, extract or positive input from outside	251.86			(330a)
Total electricity for the above, kWh/year			251.86	(331)
Electricity for lighting (Appendix L)			408.45	(332)
Total delivered energy for all uses		(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	6448.18	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from heat pump	3011.86	x	4.24	x 0.01 =	127.70	(340a)
Water heating from heat pump	2743.42	x	4.24	x 0.01 =	116.32	(342a)
Space cooling	32.59	x	13.19	x 0.01 =	4.30	(348)
Pumps and fans	251.86	x	13.19	x 0.01 =	33.22	(349)
Electricity for lighting	408.45	x	13.19	x 0.01 =	53.87	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	455.42	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.30	(357)
SAP value	81.84	
SAP rating (section 13)	82	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year	Emission factor	Emissions (kg/year)

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	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) =	3197.38	x	0.519	=	1659.44	(367)
Electrical energy for community heat distribution	57.55	x	0.519	=	29.87	(372)
Total CO2 associated with community systems					1689.31	(373)
Total CO2 associated with space and water heating					1689.31	(376)
Space cooling	32.59	x	0.519	=	16.91	(377)
Pumps and fans	251.86	x	0.519	=	130.71	(378)
Electricity for lighting	408.45	x	0.519	=	211.98	(379)
Total CO_2, kg/year				(376)..(382) =	2048.92	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	20.10	(384)
EI value					81.32	
EI rating (section 14)					81	(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) =	3197.38	x	3.07	=	9815.95	(367)
Electrical energy for community heat distribution	57.55	x	3.07	=	176.69	(372)
Total primary energy associated with community systems					9992.64	(373)
Total primary energy associated with space and water heating					9992.64	(376)
Space cooling	32.59	x	3.07	=	100.05	(377)
Pumps and fans	251.86	x	3.07	=	773.20	(378)
Electricity for lighting	408.45	x	3.07	=	1253.94	(379)
Primary energy kWh/year					12119.82	(383)
Dwelling primary energy rate kWh/m2/year					118.89	(384)

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TER Worksheet
Design - Draft

NHER

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	Miss Michelle Wang	Assessor number	2018
Client		Last modified	04/02/2019
Address	Manor Road Richmond Block 1, Richmond, TW9		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		101.94	(1a)	x	2.63	(2a)	=	268.10	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	101.94	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	268.10	(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		4	x 10 =	40	(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) =	40	÷ (5) =	0.15	(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		5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.40	(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) =	0.34	(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	0.43	0.42	0.42	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.40	(22b)

Calculate effective air change rate for the applicable case:

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	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	κ-value, kJ/m².K	A x κ, kJ/K	
Window			25.50	x	1.33	=	33.81			(27)
External wall			60.22	x	0.18	=	10.84			(29a)
Party wall			31.96	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			85.72							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	44.65	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		6.93	(36)
Total fabric heat loss	(33) + (36) =	51.58	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	52.52	52.20	51.88	50.40	50.12	48.83	48.83	48.59	49.33	50.12	50.68	51.27	(38)
Heat transfer coefficient, W/K (37)m + (38)m	104.09	103.77	103.46	101.98	101.70	100.41	100.41	100.17	100.91	101.70	102.26	102.85	
Average = ∑(39)1...12/12 =												101.98	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.02	1.02	1.01	1.00	1.00	0.99	0.99	0.98	0.99	1.00	1.00	1.01	
Average = ∑(40)1...12/12 =												1.00	(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	2.76	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.67	(43)

	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)	109.64	105.65	101.67	97.68	93.69	89.71	89.71	93.69	97.68	101.67	105.65	109.64	
∑(44)1...12 =												1196.08	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	162.59	142.21	146.74	127.93	122.76	105.93	98.16	112.64	113.98	132.84	145.00	157.46	
∑(45)1...12 =												1568.25	(45)
Distribution loss 0.15 x (45)m	24.39	21.33	22.01	19.19	18.41	15.89	14.72	16.90	17.10	19.93	21.75	23.62	(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)	1.62	(48)
Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.88	(50)
Enter (50) or (54) in (55)	0.88	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	27.16	24.54	27.16	26.29	27.16	26.29	27.16	27.16	26.29	27.16	26.29	27.16	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	27.16	24.54	27.16	26.29	27.16	26.29	27.16	27.16	26.29	27.16	26.29	27.16	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	213.02	187.75	197.17	176.74	173.18	154.73	148.59	163.07	162.78	183.26	193.80	207.89	(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	213.02	187.75	197.17	176.74	173.18	154.73	148.59	163.07	162.78	183.26	193.80	207.89	
∑(64)1...12 =												2161.99	(64)
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	94.40	83.72	89.13	81.58	81.16	74.26	72.98	77.79	76.94	84.51	87.25	92.70	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	137.84	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.13	20.54	16.71	12.65	9.45	7.98	8.62	11.21	15.05	19.10	22.30	23.77	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	259.43	262.12	255.33	240.89	222.66	205.53	194.08	191.39	198.17	212.62	230.85	247.98	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	(71)
Water heating gains (Table 5)	126.89	124.59	119.80	113.30	109.08	103.14	98.09	104.56	106.86	113.59	121.19	124.59	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	476.79	474.60	459.20	434.20	408.55	384.00	368.15	374.51	387.43	412.66	441.68	463.70	(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	
SouthEast	0.77	x	7.09	x	36.79	x 0.9 x	0.63	x	0.70	=	79.72	(77)
SouthWest	0.77	x	7.55	x	36.79	x 0.9 x	0.63	x	0.70	=	84.90	(79)
NorthWest	0.77	x	10.86	x	11.28	x 0.9 x	0.63	x	0.70	=	37.45	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	202.07	356.64	521.01	700.93	835.65	851.84	812.01	708.11	582.78	403.07	244.30	171.46	(83)
Total gains - internal and solar (73)m + (83)m	678.86	831.24	980.20	1135.13	1244.20	1235.84	1180.16	1082.62	970.21	815.73	685.98	635.16	(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)	1.00	0.99	0.97	0.88	0.71	0.51	0.37	0.42	0.68	0.94	0.99	1.00	(86)

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

	20.00	20.20	20.48	20.78	20.95	20.99	21.00	21.00	20.97	20.72	20.30	19.97	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.07	20.07	20.07	20.08	20.09	20.10	20.10	20.10	20.09	20.09	20.08	20.08	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.95	0.85	0.66	0.44	0.30	0.34	0.61	0.91	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	18.73	19.03	19.42	19.84	20.04	20.09	20.10	20.10	20.07	19.78	19.18	18.69	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
	19.31	19.56	19.90	20.27	20.45	20.50	20.51	20.51	20.48	20.21	19.69	19.27	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	19.31	19.56	19.90	20.27	20.45	20.50	20.51	20.51	20.48	20.21	19.69	19.27	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.99	0.98	0.95	0.86	0.68	0.48	0.33	0.38	0.64	0.91	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	675.04	817.80	933.72	973.93	847.16	588.07	391.97	410.58	621.24	746.07	676.49	632.59	(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]													
	1562.54	1521.51	1386.84	1159.51	890.12	592.78	392.46	411.60	643.81	977.22	1287.58	1550.29	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	660.30	472.90	337.12	133.61	31.96	0.00	0.00	0.00	0.00	171.97	439.98	682.77	

∑(98)1...5, 10...12 = 2930.61 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 28.75 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.50	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month												
	706.20	505.77	360.56	142.90	34.18	0.00	0.00	0.00	0.00	183.93	470.57	730.23

∑(211)1...5, 10...12 = 3134.34 (211)

Water heating

Efficiency of water heater													
	87.63	87.18	86.23	84.08	81.30	79.80	79.80	79.80	79.80	84.64	86.94	87.75	(217)
Water heating fuel, kWh/month													
	243.08	215.37	228.65	210.20	213.02	193.90	186.20	204.34	203.99	216.51	222.93	236.90	

∑(219a)1...12 = 2575.09 (219)

Annual totals

Space heating fuel - main system 1: 3134.34

Water heating fuel		2575.09	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		408.45	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6192.89	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3134.34	x	3.48	x 0.01 =	109.08	(240)
Water heating	2575.09	x	3.48	x 0.01 =	89.61	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	408.45	x	13.19	x 0.01 =	53.87	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	382.46	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.09	(257)
SAP value	84.75	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3134.34	x	0.216	=	677.02	(261)
Water heating	2575.09	x	0.216	=	556.22	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1233.24	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	408.45	x	0.519	=	211.98	(268)
Total CO_2, kg/year			(265)...(271) =		1484.15	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		21.21	(273)
EI value					86.47	
EI rating (section 14)					86	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3134.34	x	1.22	=	3823.90	(261)
Water heating	2575.09	x	1.22	=	3141.61	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6965.51	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	408.45	x	3.07	=	1253.94	(268)
Primary energy kWh/year					8449.70	(272)
Dwelling primary energy rate kWh/m2/year					82.89	(273)

Appendix I: BRUKL summary

Be lean BRUKL

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Manor Road - Retail A1 (Lean) As designed

Date: Fri Jan 25 17:34:01 2019

Administrative information

Building Details

Address: Richmond, London, TW9

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.10

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.10

BRUKL compliance check version: v5.4.b.0

Owner Details

Name: Avanton Richmond Development Ltd.

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	43.8
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	43.8
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	33.6
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.15	0.15	00000001:Surf[2]
Floor	0.25	0.13	0.13	00000001:Surf[0]
Roof	0.25	0.16	0.16	00000001:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.4	1.4	00000001:Surf[3]
Personnel doors	2.2	1.4	1.4	00000001:Surf[4]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	3

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Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	434.5	434.5
External area [m²]	965.6	965.6
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	311.82	399.49
Average U-value [W/m²K]	0.32	0.41
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	11.55	13.15
Cooling	5.88	8.82
Auxiliary	16.97	17.66
Lighting	37.77	53.7
Hot water	1.86	1.86
Equipment*	20.26	20.26
TOTAL**	**74.04**	**95.19**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	127.99	161.17
Primary energy* [kWh/m²]	197.83	258.32
Total emissions [kg/m²]	33.6	43.8

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

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Be green BRUKL

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Manor Road - Retail A1 (Green)

As designed

Date: Fri Jan 25 17:39:38 2019

Administrative information

Building Details

Address: Richmond, London, TW9

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.10

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.10

BRUKL compliance check version: v5.4.b.0

Owner Details

Name: Avanton Richmond Development Ltd.

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	36
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	36
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	27.3
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

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Floor	0.25	0.13	0.13	00000001:Surf[0]
Roof	0.25	0.16	0.16	00000001:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.4	1.4	00000001:Surf[3]
Personnel doors	2.2	1.4	1.4	00000001:Surf[4]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	3

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Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	434.5	434.5
External area [m²]	965.6	965.6
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	311.82	399.49
Average U-value [W/m²K]	0.32	0.41
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	1.98	4.43
Cooling	5.32	8.82
Auxiliary	7.13	3.06
Lighting	37.77	53.7
Hot water	1.7	1.86
Equipment*	20.26	20.26
TOTAL**	**53.9**	**71.88**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	127.99	161.17
Primary energy* [kWh/m²]	167.27	224.88
Total emissions [kg/m²]	27.3	36

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

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Appendix J: Boiler and ASHP operational cost analysis

	Communal gas boiler			**ASHP + local storage with immersion**			**ASHP + local storage with immersion**		
	Communal gas boiler			**Communal ASHP**			**Communal ASHP**		
	Equivalent heat price	p/kWh	**4.0**	Equivalent heat price (inc. RHI)	p/kWh	**2.5**	Equivalent heat price (excl. RHI)	p/kWh	**5.6**
						Yes			No
System Inputs	Tenant heat demand	kWh/yr	1	Tenant heat demand	kWh/yr	1	Tenant heat demand	kWh/yr	1
	Proportion of demand is space heat	-	0.50	Proportion of demand is space heat	-	0.33	Proportion of demand is space heat	-	0.33
	Proportion of demand is DHW	-	0.50	Proportion of demand is DHW	-	0.67	Proportion of demand is DHW	-	0.67
	Communal distribution heat losses	-	0.30	Communal distribution heat losses	-	0.19	Communal distribution heat losses	-	0.19
	Communal storage heat losses	-	0.00	Communal storage heat losses	-	0.00	Communal storage heat losses	-	0.00
	Gas boiler efficiency	-	0.95	Gas boiler efficiency	-	-	Gas boiler efficiency	-	-
	Pumping energy % of heat generated	-	0.01	Pumping energy % of heat generated	-	0.01	Pumping energy % of heat generated	-	0.01
	Cold water flow temp	C	10	Cold water flow temp	C	10	Cold water flow temp	C	10
	Hot water storage temp	C	-	Hot water storage temp	C	60	Hot water storage temp	C	60
	Communal distribution flow temp	C	70	Communal distribution flow temp	C	55	Communal distribution flow temp	C	55
	Communal distribution return temp	C	40	Communal distribution return temp	C	30	Communal distribution return temp	C	30
				Electric heating efficiency	-	1.00	Electric heating efficiency	-	1.00
				ASHP heating efficiency	-	2.90	ASHP heating efficiency	-	2.90
Calculation	Heat generated	kWh/yr	1.429	Percentage of communal hot water	-	0.90	Percentage of communal hot water	-	0.90
				Percentage of local storage hot water	-	0.10	Percentage of local storage hot water	-	0.10
				Communal heat generated	kWh/yr	1.156	Communal heat generated	kWh/yr	1.156
				Tenant heat generated	kWh/yr	0.067	Tenant heat generated	kWh/yr	0.067
Output (heat system)	Landlord gas consumption	kWh/yr	1.504	Landlord gas consumption	kWh/yr	0.000	Landlord gas consumption	kWh/yr	0.000
	Landlord electricity consumption	kWh/yr	0.014	Landlord electricity consumption	kWh/yr	0.410	Landlord electricity consumption	kWh/yr	0.410
	Tenant electricity consumption	kWh/yr	0.000	Tenant electricity consumption	kWh/yr	0.067	Tenant electricity consumption	kWh/yr	0.067
	Total net energy consumption	kWh/yr	1.518	Total net energy consumption	kWh/yr	0.477	Total net energy consumption	kWh/yr	0.477
	Landlord gas consumption	p	3.865	Landlord gas consumption	p	0.000	Landlord gas consumption	p	0.000
	Landlord electricity consumption	p	0.158	Landlord electricity consumption	p	4.530	Landlord electricity consumption	p	4.530
	Landlord RHI	p	0.000	Landlord RHI	p	-3.110	Landlord RHI	p	0.000
	Tenant gas consumption	p	0.000	Tenant gas consumption	p	0.000	Tenant gas consumption	p	0.000
	Tenant electricity consumption	p	0.000	Tenant electricity consumption	p	1.099	Tenant electricity consumption	p	1.099
	Total energy consumption	p	4.022	Total energy consumption	p	2.518	Total energy consumption	p	5.629

Table 23: Boiler & ASHP operational cost analysis inputs and results

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