

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       | B4-A-09-06 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  | <input type="text" value="78.00"/> (1a)                                    | x | <input type="text" value="2.55"/> (2a) | = | <input type="text" value="198.90"/> (3a) |
| Total floor area | (1a) + (1b) + (1c) + (1d)...(1n) = <input type="text" value="78.00"/> (4)  |   |  |   |  |
| Dwelling volume  | (3a) + (3b) + (3c) + (3d)...(3n) = <input type="text" value="198.90"/> (5) |   |  |   |  |

### 2. Ventilation rate

|                              |                                |        | m <sup>3</sup> per hour              |
|------------------------------|--------------------------------|--------|--------------------------------------|
| Number of chimneys           | <input type="text" value="0"/> | x 40 = | <input type="text" value="0"/> (6a)  |
| Number of open flues         | <input type="text" value="0"/> | x 20 = | <input type="text" value="0"/> (6b)  |
| Number of intermittent fans  | <input type="text" value="3"/> | x 10 = | <input type="text" value="30"/> (7a) |
| Number of passive vents      | <input type="text" value="0"/> | x 10 = | <input type="text" value="0"/> (7b)  |
| Number of flueless gas fires | <input type="text" value="0"/> | x 40 = | <input type="text" value="0"/> (7c)  |

|   |  |         | Air changes per hour                  |
|---|--|---------|---------------------------------------|
| Infiltration due to chimneys, flues, fans, PSVs | (6a) + (6b) + (7a) + (7b) + (7c) = <input type="text" value="30"/> | ÷ (5) = | <input type="text" value="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, q <sub>50</sub> , expressed in cubic metres per hour per square metre of envelope area | <input type="text" value="5.00"/> (17) |
|--|--|

|  |  |
|--|--|
| If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) | <input type="text" value="0.40"/> (18) |
|--|--|

|  |                                     |
|--|-------------------------------------|
| Number of sides on which the dwelling is sheltered | <input type="text" value="2"/> (19) |
|--|-------------------------------------|

|                |   |
|----------------|---|
| Shelter factor | 1 - [0.075 x (19)] = <input type="text" value="0.85"/> (20) |
|----------------|---|

|  |  |
|--|--|
| Infiltration rate incorporating shelter factor | (18) x (20) = <input type="text" value="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 | <input type="text" value="5.10"/> | <input type="text" value="5.00"/> | <input type="text" value="4.90"/> | <input type="text" value="4.40"/> | <input type="text" value="4.30"/> | <input type="text" value="3.80"/> | <input type="text" value="3.80"/> | <input type="text" value="3.70"/> | <input type="text" value="4.00"/> | <input type="text" value="4.30"/> | <input type="text" value="4.50"/> | <input type="text" value="4.70"/> (22) |

|                       |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |   |
|-----------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---|
| Wind factor (22)m ÷ 4 | <input type="text" value="1.28"/> | <input type="text" value="1.25"/> | <input type="text" value="1.23"/> | <input type="text" value="1.10"/> | <input type="text" value="1.08"/> | <input type="text" value="0.95"/> | <input type="text" value="0.95"/> | <input type="text" value="0.93"/> | <input type="text" value="1.00"/> | <input type="text" value="1.08"/> | <input type="text" value="1.13"/> | <input type="text" value="1.18"/> (22a) |
|-----------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---|

|   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |   |
|---|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---|
| Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m | <input type="text" value="0.43"/> | <input type="text" value="0.43"/> | <input type="text" value="0.42"/> | <input type="text" value="0.37"/> | <input type="text" value="0.37"/> | <input type="text" value="0.32"/> | <input type="text" value="0.32"/> | <input type="text" value="0.32"/> | <input type="text" value="0.34"/> | <input type="text" value="0.37"/> | <input type="text" value="0.38"/> | <input type="text" value="0.40"/> (22b) |
|---|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---|

Calculate effective air change rate for the applicable case:

|   |  |
|---|--|
| If mechanical ventilation: air change rate through system | <input type="text" value="N/A"/> (23a) |
|---|--|

|  |  |
|--|--|
| If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h | <input type="text" value="N/A"/> (23c) |
|--|--|

d) natural ventilation or whole house positive input ventilation from loft

|                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |   |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---|
| <input type="text" value="0.59"/> | <input type="text" value="0.59"/> | <input type="text" value="0.59"/> | <input type="text" value="0.57"/> | <input type="text" value="0.57"/> | <input type="text" value="0.55"/> | <input type="text" value="0.55"/> | <input type="text" value="0.55"/> | <input type="text" value="0.56"/> | <input type="text" value="0.57"/> | <input type="text" value="0.57"/> | <input type="text" value="0.58"/> (24d) |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---|

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

|                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |  |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|--|
| <input type="text" value="0.59"/> | <input type="text" value="0.59"/> | <input type="text" value="0.59"/> | <input type="text" value="0.57"/> | <input type="text" value="0.57"/> | <input type="text" value="0.55"/> | <input type="text" value="0.55"/> | <input type="text" value="0.55"/> | <input type="text" value="0.56"/> | <input type="text" value="0.57"/> | <input type="text" value="0.57"/> | <input type="text" value="0.58"/> (25) |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|--|

### 3. Heat losses and heat loss parameter

| Element   | Gross<br>area, m <sup>2</sup> | Openings<br>m <sup>2</sup> | Net area<br>A, m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U W/K                            | κ-value,<br>kJ/m <sup>2</sup> .K | A x κ,<br>kJ/K |       |       |       |       |       |      |
|---|-------------------------------|----------------------------|-------------------------------|-------------------------------|--------------------------------------|----------------------------------|----------------|-------|-------|-------|-------|-------|------|
| Window  |                               |                            | 18.21                         | 1.33                          | 24.14                                |                                  | (27)           |       |       |       |       |       |      |
| External wall   |                               |                            | 19.17                         | 0.18                          | 3.45                                 |                                  | (29a)          |       |       |       |       |       |      |
| Party wall  |                               |                            | 64.70                         | 0.00                          | 0.00                                 |                                  | (32)           |       |       |       |       |       |      |
| Roof  |                               |                            | 22.35                         | 0.13                          | 2.91                                 |                                  | (30)           |       |       |       |       |       |      |
| Total area of external elements ΣA, m <sup>2</sup>          |                               |                            | 59.73                         |                               |                                      |                                  | (31)           |       |       |       |       |       |      |
| Fabric heat loss, W/K = Σ(A × U)                            |                               |                            |                               |                               | (26)...(30) + (32) =                 | 30.50                            | (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       |                               |                            |                               |                               |                                      | 2.99                             | (36)           |       |       |       |       |       |      |
| Total fabric heat loss                                      |                               |                            |                               |                               | (33) + (36) =                        | 33.48                            | (37)           |       |       |       |       |       |      |
|   | Jan                           | Feb                        | Mar                           | Apr                           | May                                  | Jun                              | Jul            | Aug   | Sep   | Oct   | Nov   | Dec   |      |
| Ventilation heat loss calculated monthly 0.33 × (25)m × (5) | 39.01                         | 38.77                      | 38.54                         | 37.43                         | 37.22                                | 36.26                            | 36.26          | 36.08 | 36.63 | 37.22 | 37.64 | 38.08 | (38) |
| Heat transfer coefficient, W/K (37)m + (38)m                | 72.50                         | 72.26                      | 72.02                         | 70.91                         | 70.71                                | 69.74                            | 69.74          | 69.56 | 70.11 | 70.71 | 71.12 | 71.56 |      |
|   | Average = Σ(39)1...12/12 =    |                            |                               |                               |                                      |                                  |                |       |       |       |       | 70.91 | (39) |
| Heat loss parameter (HLP), W/m <sup>2</sup> K (39)m ÷ (4)   | 0.93                          | 0.93                       | 0.92                          | 0.91                          | 0.91                                 | 0.89                             | 0.89           | 0.89  | 0.90  | 0.91  | 0.91  | 0.92  |      |
|   | Average = Σ(40)1...12/12 =    |                            |                               |                               |                                      |                                  |                |       |       |       |       | 0.91  | (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   |        |        |        |        |        |       |       |        |        |        |        | 2.42                    | (42)    |      |
| Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$                                  |        |        |        |        |        |       |       |        |        |        |        | 91.77                   | (43)    |      |
|  | Jan    | Feb    | Mar    | Apr    | May    | Jun   | Jul   | Aug    | Sep    | Oct    | Nov    | Dec                     |         |      |
| Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$                   |        |        |        |        |        |       |       |        |        |        |        |                         |         |      |
|  | 100.94 | 97.27  | 93.60  | 89.93  | 86.26  | 82.59 | 82.59 | 86.26  | 89.93  | 93.60  | 97.27  | 100.94                  |         |      |
|  |        |        |        |        |        |       |       |        |        |        |        | $\Sigma(44)_{1...12} =$ | 1101.19 | (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) |        |        |        |        |        |       |       |        |        |        |        |                         |         |      |
|  | 149.69 | 130.92 | 135.10 | 117.78 | 113.02 | 97.53 | 90.37 | 103.70 | 104.94 | 122.30 | 133.50 | 144.97                  |         |      |
|  |        |        |        |        |        |       |       |        |        |        |        | $\Sigma(45)_{1...12} =$ | 1443.83 | (45) |
| Distribution loss $0.15 \times (45)m$  |        |        |        |        |        |       |       |        |        |        |        |                         |         |      |
|  | 22.45  | 19.64  | 20.27  | 17.67  | 16.95  | 14.63 | 13.56 | 15.56  | 15.74  | 18.34  | 20.02  | 21.75                   | (46)    |      |
| Storage volume (litres) including any solar or WWHRS storage within same vessel  |        |        |        |        |        |       |       |        |        |        |        | 4.00                    | (47)    |      |
| Water storage loss:  |        |        |        |        |        |       |       |        |        |        |        |                         |         |      |
| a) If manufacturer's declared loss factor is known (kWh/day)   |        |        |        |        |        |       |       |        |        |        |        | 0.28                    | (48)    |      |
| Temperature factor from Table 2b   |        |        |        |        |        |       |       |        |        |        |        | 0.54                    | (49)    |      |
| Energy lost from water storage (kWh/day) $(48) \times (49)$  |        |        |        |        |        |       |       |        |        |        |        | 0.15                    | (50)    |      |
| Enter (50) or (54) in (55)   |        |        |        |        |        |       |       |        |        |        |        | 0.15                    | (55)    |      |
| Water storage loss calculated for each month $(55) \times (41)m$   |        |        |        |        |        |       |       |        |        |        |        |                         |         |      |
|  | 4.67   | 4.22   | 4.67   | 4.52   | 4.67   | 4.52  | 4.67  | 4.67   | 4.52   | 4.67   | 4.52   | 4.67                    | (56)    |      |
| If the vessel contains dedicated solar storage or dedicated WWHRS $(56)m \times [(47) - V_s] \div (47)$ , else (56)    |        |        |        |        |        |       |       |        |        |        |        |                         |         |      |
|  | 4.67   | 4.22   | 4.67   | 4.52   | 4.67   | 4.52  | 4.67  | 4.67   | 4.52   | 4.67   | 4.52   | 4.67                    | (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  $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

|        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| 177.63 | 156.16 | 163.04 | 144.82 | 140.95 | 124.56 | 118.31 | 131.64 | 131.98 | 150.24 | 160.53 | 172.91 | (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)  $(62)m + (63)m$

|                      |        |        |        |        |        |        |        |        |        |        |         |      |
|----------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|------|
| 177.63               | 156.16 | 163.04 | 144.82 | 140.95 | 124.56 | 118.31 | 131.64 | 131.98 | 150.24 | 160.53 | 172.91  |      |
| $\Sigma(64)1...12 =$ |        |        |        |        |        |        |        |        |        |        | 1772.76 | (64) |

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

|       |       |       |       |       |       |       |       |       |       |       |       |      |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 72.12 | 63.72 | 67.27 | 60.79 | 59.93 | 54.06 | 52.40 | 56.83 | 56.52 | 63.01 | 66.02 | 70.55 | (65) |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

## 5. Internal gains

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

Metabolic gains (Table 5)

|        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| 121.19 | 121.19 | 121.19 | 121.19 | 121.19 | 121.19 | 121.19 | 121.19 | 121.19 | 121.19 | 121.19 | 121.19 | (66) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

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

|       |       |       |       |      |      |      |      |       |       |       |       |      |
|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|------|
| 19.19 | 17.04 | 13.86 | 10.49 | 7.84 | 6.62 | 7.15 | 9.30 | 12.48 | 15.85 | 18.50 | 19.72 | (67) |
|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|------|

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

|        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| 215.21 | 217.44 | 211.82 | 199.83 | 184.71 | 170.50 | 161.00 | 158.77 | 164.40 | 176.38 | 191.50 | 205.71 | (68) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

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

|       |       |       |       |       |       |       |       |       |       |       |       |      |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 35.12 | 35.12 | 35.12 | 35.12 | 35.12 | 35.12 | 35.12 | 35.12 | 35.12 | 35.12 | 35.12 | 35.12 | (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)

|        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| -96.95 | -96.95 | -96.95 | -96.95 | -96.95 | -96.95 | -96.95 | -96.95 | -96.95 | -96.95 | -96.95 | -96.95 | (71) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

Water heating gains (Table 5)

|       |       |       |       |       |       |       |       |       |       |       |       |      |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 96.94 | 94.82 | 90.42 | 84.43 | 80.55 | 75.08 | 70.43 | 76.39 | 78.50 | 84.70 | 91.69 | 94.83 | (72) |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| 393.69 | 391.66 | 378.45 | 357.12 | 335.46 | 314.55 | 300.94 | 306.81 | 317.74 | 339.28 | 364.05 | 382.62 | (73) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

## 6. Solar gains

|           | Access factor<br>Table 6d |   | Area<br>m <sup>2</sup> |   | Solar flux<br>W/m <sup>2</sup> |       | g<br>specific data<br>or Table 6b |      | FF<br>specific data<br>or Table 6c |      | Gains<br>W |       |      |
|-----------|---------------------------|---|------------------------|---|--------------------------------|-------|-----------------------------------|------|------------------------------------|------|------------|-------|------|
| NorthEast | 0.77                      | x | 18.21                  | x | 11.28                          | x 0.9 | x                                 | 0.63 | x                                  | 0.70 | =          | 62.79 | (75) |

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

|       |        |        |        |        |        |        |        |        |        |       |       |      |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|------|
| 62.79 | 127.81 | 230.28 | 378.19 | 508.36 | 541.97 | 507.00 | 404.18 | 280.60 | 156.20 | 79.01 | 51.28 | (83) |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|------|

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

|        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| 456.48 | 519.48 | 608.73 | 735.31 | 843.82 | 856.52 | 807.94 | 711.00 | 598.34 | 495.48 | 443.05 | 433.90 | (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 | 1.00 | 0.98 | 0.92 | 0.73 | 0.52 | 0.38 | 0.45 | 0.75 | 0.97 | 1.00 | 1.00 | (86) |
|------|------|------|------|------|------|------|------|------|------|------|------|------|

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

|       |       |       |       |       |       |       |       |       |       |       |       |      |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 20.05 | 20.19 | 20.44 | 20.77 | 20.95 | 21.00 | 21.00 | 21.00 | 20.96 | 20.68 | 20.31 | 20.03 | (87) |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 20.14 | 20.15 | 20.15 | 20.16 | 20.16 | 20.17 | 20.17 | 20.17 | 20.17 | 20.16 | 20.16 | 20.15 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(88)

Utilisation factor for gains for rest of dwelling n2,m

|      |      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|------|
| 1.00 | 0.99 | 0.98 | 0.89 | 0.68 | 0.45 | 0.31 | 0.37 | 0.68 | 0.96 | 0.99 | 1.00 |
|------|------|------|------|------|------|------|------|------|------|------|------|

(89)

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

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 18.87 | 19.07 | 19.43 | 19.90 | 20.12 | 20.17 | 20.17 | 20.17 | 20.14 | 19.79 | 19.26 | 18.85 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(90)

Living area fraction

Living area ÷ (4) = 0.47

(91)

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

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 19.42 | 19.59 | 19.91 | 20.30 | 20.51 | 20.56 | 20.56 | 20.56 | 20.52 | 20.20 | 19.75 | 19.40 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(92)

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

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 19.42 | 19.59 | 19.91 | 20.30 | 20.51 | 20.56 | 20.56 | 20.56 | 20.52 | 20.20 | 19.75 | 19.40 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(93)

## 8. Space heating requirement

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

Utilisation factor for gains, ηm

|      |      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|------|
| 1.00 | 0.99 | 0.98 | 0.90 | 0.70 | 0.48 | 0.34 | 0.41 | 0.72 | 0.96 | 0.99 | 1.00 |
|------|------|------|------|------|------|------|------|------|------|------|------|

(94)

Useful gains, ηmGm, W (94)m x (84)m

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 455.07 | 515.80 | 594.11 | 659.14 | 593.96 | 412.91 | 275.89 | 288.70 | 427.97 | 473.61 | 440.00 | 432.89 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(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]

|         |         |        |        |        |        |        |        |        |        |        |         |
|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|
| 1096.36 | 1061.68 | 965.44 | 808.70 | 622.83 | 415.37 | 276.13 | 289.36 | 450.29 | 679.09 | 899.75 | 1087.94 |
|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|

(97)

Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

|        |        |        |        |       |      |      |      |      |        |        |        |
|--------|--------|--------|--------|-------|------|------|------|------|--------|--------|--------|
| 477.12 | 366.83 | 276.27 | 107.69 | 21.48 | 0.00 | 0.00 | 0.00 | 0.00 | 152.87 | 331.02 | 487.36 |
|--------|--------|--------|--------|-------|------|------|------|------|--------|--------|--------|

Σ(98)1...5, 10...12 = 2220.63

(98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 28.47

(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

|        |        |        |        |       |      |      |      |      |        |        |        |
|--------|--------|--------|--------|-------|------|------|------|------|--------|--------|--------|
| 510.29 | 392.33 | 295.48 | 115.17 | 22.97 | 0.00 | 0.00 | 0.00 | 0.00 | 163.50 | 354.04 | 521.24 |
|--------|--------|--------|--------|-------|------|------|------|------|--------|--------|--------|

Σ(211)1...5, 10...12 = 2375.00

(211)

### Water heating

Efficiency of water heater

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 87.32 | 87.02 | 86.21 | 84.04 | 81.07 | 79.80 | 79.80 | 79.80 | 79.80 | 84.86 | 86.70 | 87.43 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(217)

Water heating fuel, kWh/month

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 203.42 | 179.46 | 189.12 | 172.33 | 173.87 | 156.09 | 148.26 | 164.96 | 165.38 | 177.04 | 185.15 | 197.77 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

Σ(219a)1...12 = 2112.85

(219)

### Annual totals

Space heating fuel - main system 1

2375.00

Water heating fuel

2112.85

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)                           | 338.83                                   | (232)         |
| Total delivered energy for all uses                             | (211)...(221) + (231) + (232)...(237b) = | 4901.69 (238) |

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

|                               | Fuel<br>kWh/year |   | Fuel price |                                 | Fuel<br>cost £/year |       |
|-------------------------------|------------------|---|------------|---------------------------------|---------------------|-------|
| Space heating - main system 1 | 2375.00          | x | 3.48       | x 0.01 =                        | 82.65               | (240) |
| Water heating                 | 2112.85          | x | 3.48       | x 0.01 =                        | 73.53               | (247) |
| Pumps and fans                | 75.00            | x | 13.19      | x 0.01 =                        | 9.89                | (249) |
| Electricity for lighting      | 338.83           | x | 13.19      | x 0.01 =                        | 44.69               | (250) |
| Additional standing charges   |                  |   |            |                                 | 120.00              | (251) |
| Total energy cost             |                  |   |            | (240)...(242) + (245)...(254) = | 330.76              | (255) |

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

|                                 |       |       |
|---------------------------------|-------|-------|
| Energy cost deflator (Table 12) | 0.42  | (256) |
| Energy cost factor (ECF)        | 1.13  | (257) |
| SAP value                       | 84.24 |       |
| SAP rating (section 13)         | 84    | (258) |
| SAP band                        | B     |       |

#### 12a. CO<sub>2</sub> emissions - individual heating systems including micro-CHP

|  | Energy<br>kWh/year |   | Emission factor<br>kg CO <sub>2</sub> /kWh |                 | Emissions<br>kg CO <sub>2</sub> /year |       |
|--|--------------------|---|--|-----------------|---------------------------------------|-------|
| Space heating - main system 1          | 2375.00            | x | 0.216                                      | =               | 513.00                                | (261) |
| Water heating                          | 2112.85            | x | 0.216                                      | =               | 456.38                                | (264) |
| Space and water heating                |                    |   | (261) + (262) + (263) + (264) =            |                 | 969.38                                | (265) |
| Pumps and fans                         | 75.00              | x | 0.519                                      | =               | 38.93                                 | (267) |
| Electricity for lighting               | 338.83             | x | 0.519                                      | =               | 175.85                                | (268) |
| Total CO <sub>2</sub> , kg/year        |                    |   |  | (265)...(271) = | 1184.16                               | (272) |
| Dwelling CO <sub>2</sub> emission rate |                    |   |  | (272) ÷ (4) =   | 15.18                                 | (273) |
| EI value                               |                    |   |  |                 | 87.10                                 |       |
| EI rating (section 14)                 |                    |   |  |                 | 87                                    | (274) |
| EI band                                |                    |   |  |                 | B                                     |       |

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

|   | Energy<br>kWh/year |   | Primary factor                  |   | Primary Energy<br>kWh/year |       |
|---|--------------------|---|---------------------------------|---|----------------------------|-------|
| Space heating - main system 1                         | 2375.00            | x | 1.22                            | = | 2897.51                    | (261) |
| Water heating   | 2112.85            | x | 1.22                            | = | 2577.67                    | (264) |
| Space and water heating                               |                    |   | (261) + (262) + (263) + (264) = |   | 5475.18                    | (265) |
| Pumps and fans  | 75.00              | x | 3.07                            | = | 230.25                     | (267) |
| Electricity for lighting                              | 338.83             | x | 3.07                            | = | 1040.22                    | (268) |
| Primary energy kWh/year                               |                    |   |                                 |   | 6745.65                    | (272) |
| Dwelling primary energy rate kWh/m <sup>2</sup> /year |                    |   |                                 |   | 86.48                      | (273) |