# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | George Farr | **Stroma Number:** | STRO028460 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.10 |

## Property Address: 99 Camden Mews

**Address :**

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 58.14 (1a) | x | 2.42 (2a) | = | 140.99 | (3a) |
| First floor | 65.26 (1b) | x | 2.88 (2b) | = | 187.62 | (3b) |
| Second floor | 25.9 (1c) | x | 2.75 (2c) | = | 71.22 | (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 149.3 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | = | 399.84 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 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 and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.1 (8) |

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

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | | 0 (9) |
| Additional infiltration | | [(9)-1]x0.1 = | 0 (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | | 0 (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | | 0 (12) |
| If no draught lobby, enter 0.05, else enter 0 | | | 0 (13) |
| Percentage of windows and doors draught stripped | | | 0 (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | | 0 (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | | 0 (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | | 3.5 (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | 0.28 (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | | 2 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 0.85 (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | | 0.23 (21) |

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

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Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.3 | 0.29 | 0.29 | 0.26 | 0.25 | 0.22 | 0.22 | 0.22 | 0.23 | 0.25 | 0.26 | 0.27 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.54 | 0.54 | 0.54 | 0.53 | 0.53 | 0.52 | 0.52 | 0.52 | 0.53 | 0.53 | 0.53 | 0.54 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.54 | 0.54 | 0.54 | 0.53 | 0.53 | 0.52 | 0.52 | 0.52 | 0.53 | 0.53 | 0.53 | 0.54 |

(25)

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors Type 1 | | | 2.34 | x | 1.2 | = | 2.808 | | | (26) |
| Doors Type 2 | | | 2.12 | x | 1.2 | = | 2.544 | | | (26) |
| Windows Type 1 | | | 24.18 | x1/[1/( 1.2 )+ 0.04] | | = | 27.69 | | | (27) |
| Windows Type 2 | | | 26.58 | x1/[1/( 1.2 )+ 0.04] | | = | 30.44 | | | (27) |
| Windows Type 3 | | | 2.94 | x1/[1/( 1.2 )+ 0.04] | | = | 3.37 | | | (27) |
| Rooflights | | | 9.79 | x1/[1/(1.2) + 0.04] | | = | 11.748 | | | (27b) |
| Floor | | | 58.14 | x | 0.14 | = | 8.1396 | 110 | 6395.4 | (28) |
| Walls Type1 | 114.3 | 58.16 | 56.14 | x | 0.18 | = | 10.11 | 60 | 3368.4 | (29) |
| Walls Type2 | 72.61 | 0 | 72.61 | x | 0.18 | = | 13.07 | 14 | 1016.54 | (29) |
| Roof | 65.12 | 9.79 | 55.33 | x | 0.12 | = | 6.64 | 9 | 497.97 | (30) |
| Total area of elements, m² | | | 310.17 | | | | | | | (31) |
| Party wall | | | 64.23 | x | 0 | = | 0 | 110 | 7065.3 | (32) |
| Internal wall ** | | | 182.06 | | | | | 9 | 1638.54 | (32c) |
| Internal floor | | | 84.96 | | | | | 18 | 1529.28 | (32d) |
| Internal ceiling | | | 84.96 | | | | | 9 | 764.64 | (32e) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 116 (33)

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Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 22276.07 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 149.2 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 31.45 (36)

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

Total fabric heat loss (33) + (36) = 147.45 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 71.83 | 71.61 | 71.38 | 70.34 | 70.14 | 69.23 | 69.23 | 69.06 | 69.58 | 70.14 | 70.54 | 70.95 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 219.29 | 219.06 | 218.84 | 217.79 | 217.59 | 216.68 | 216.68 | 216.51 | 217.03 | 217.59 | 217.99 | 218.4 | |

Average = Sum(39)$_{1...12}$ /12= 217.79 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.47 | 1.47 | 1.47 | 1.46 | 1.46 | 1.45 | 1.45 | 1.45 | 1.45 | 1.46 | 1.46 | 1.46 | |

Average = Sum(40)$_{1...12}$ /12= 1.46 (40)

Number of days in month (Table 1a)

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

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.93 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 103.86 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

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

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 114.25 | 110.09 | 105.94 | 101.78 | 97.63 | 93.47 | 93.47 | 97.63 | 101.78 | 105.94 | 110.09 | 114.25 | |

Total = Sum(44)$_{1...12}$ = 1246.33 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 169.42 | 148.18 | 152.91 | 133.31 | 127.91 | 110.38 | 102.28 | 117.37 | 118.77 | 138.42 | 151.09 | 164.08 | |

Total = Sum(45)$_{1...12}$ = 1634.14 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25.41 | 22.23 | 22.94 | 20 | 19.19 | 16.56 | 15.34 | 17.61 | 17.82 | 20.76 | 22.66 | 24.61 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

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| | | | |
|---|---|---|---|
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | 0 | (51) |
| If community heating see section 4.3 | | | |
| Volume factor from Table 2a | | 0 | (52) |
| Temperature factor from Table 2b | | 0 | (53) |
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 0 | (54) |
| Enter (50) or (54) in (55) | | 0 | (55) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

| | | |
|---|---|---|
| Primary circuit loss (annual) from Table 3 | 0 | (58) |

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 26.52 | 23.94 | 26.45 | 25.53 | 26.32 | 25.4 | 26.19 | 26.28 | 25.47 | 26.39 | 25.61 | 26.5 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 195.95 | 172.12 | 179.36 | 158.84 | 154.24 | 135.78 | 128.48 | 143.65 | 144.24 | 164.8 | 176.71 | 190.58 | (62) |

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 195.95 | 172.12 | 179.36 | 158.84 | 154.24 | 135.78 | 128.48 | 143.65 | 144.24 | 164.8 | 176.71 | 190.58 | |

Output from water heater (annual)$_{1...12}$ 1944.73 (64)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 62.96 | 55.25 | 57.45 | 50.71 | 49.11 | 43.05 | 40.56 | 45.6 | 45.86 | 52.62 | 56.64 | 61.18 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 146.65 | 146.65 | 146.65 | 146.65 | 146.65 | 146.65 | 146.65 | 146.65 | 146.65 | 146.65 | 146.65 | 146.65 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 28.51 | 25.32 | 20.59 | 15.59 | 11.65 | 9.84 | 10.63 | 13.82 | 18.55 | 23.55 | 27.48 | 29.3 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 319.76 | 323.08 | 314.72 | 296.92 | 274.45 | 253.33 | 239.22 | 235.9 | 244.26 | 262.06 | 284.53 | 305.65 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.67 | 37.67 | 37.67 | 37.67 | 37.67 | 37.67 | 37.67 | 37.67 | 37.67 | 37.67 | 37.67 | 37.67 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -117.32 | -117.32 | -117.32 | -117.32 | -117.32 | -117.32 | -117.32 | -117.32 | -117.32 | -117.32 | -117.32 | -117.32 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 84.63 | 82.22 | 77.22 | 70.43 | 66.01 | 59.79 | 54.51 | 61.28 | 63.69 | 70.73 | 78.67 | 82.23 | (72) |

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

| (73)m= | 502.89 | 500.62 | 482.53 | 452.93 | 422.11 | 392.95 | 374.36 | 381 | 396.5 | 426.33 | 460.68 | 487.18 | (73) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

## 6. Solar gains:

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

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 24.18 | x | 36.79 | x | 0.53 | x | 0.7 | = | 228.74 | (77) |
| Southeast 0.9x | 0.77 | x | 24.18 | x | 62.67 | x | 0.53 | x | 0.7 | = | 389.63 | (77) |
| Southeast 0.9x | 0.77 | x | 24.18 | x | 85.75 | x | 0.53 | x | 0.7 | = | 533.1 | (77) |
| Southeast 0.9x | 0.77 | x | 24.18 | x | 106.25 | x | 0.53 | x | 0.7 | = | 660.54 | (77) |
| Southeast 0.9x | 0.77 | x | 24.18 | x | 119.01 | x | 0.53 | x | 0.7 | = | 739.86 | (77) |
| Southeast 0.9x | 0.77 | x | 24.18 | x | 118.15 | x | 0.53 | x | 0.7 | = | 734.51 | (77) |
| Southeast 0.9x | 0.77 | x | 24.18 | x | 113.91 | x | 0.53 | x | 0.7 | = | 708.15 | (77) |
| Southeast 0.9x | 0.77 | x | 24.18 | x | 104.39 | x | 0.53 | x | 0.7 | = | 648.97 | (77) |
| Southeast 0.9x | 0.77 | x | 24.18 | x | 92.85 | x | 0.53 | x | 0.7 | = | 577.24 | (77) |
| Southeast 0.9x | 0.77 | x | 24.18 | x | 69.27 | x | 0.53 | x | 0.7 | = | 430.62 | (77) |
| Southeast 0.9x | 0.77 | x | 24.18 | x | 44.07 | x | 0.53 | x | 0.7 | = | 273.98 | (77) |
| Southeast 0.9x | 0.77 | x | 24.18 | x | 31.49 | x | 0.53 | x | 0.7 | = | 195.75 | (77) |
| Southwest 0.9x | 0.77 | x | 2.94 | x | 36.79 | | 0.53 | x | 0.7 | = | 27.81 | (79) |
| Southwest 0.9x | 0.77 | x | 2.94 | x | 62.67 | | 0.53 | x | 0.7 | = | 47.37 | (79) |
| Southwest 0.9x | 0.77 | x | 2.94 | x | 85.75 | | 0.53 | x | 0.7 | = | 64.82 | (79) |
| Southwest 0.9x | 0.77 | x | 2.94 | x | 106.25 | | 0.53 | x | 0.7 | = | 80.31 | (79) |
| Southwest 0.9x | 0.77 | x | 2.94 | x | 119.01 | | 0.53 | x | 0.7 | = | 89.96 | (79) |
| Southwest 0.9x | 0.77 | x | 2.94 | x | 118.15 | | 0.53 | x | 0.7 | = | 89.31 | (79) |
| Southwest 0.9x | 0.77 | x | 2.94 | x | 113.91 | | 0.53 | x | 0.7 | = | 86.1 | (79) |
| Southwest 0.9x | 0.77 | x | 2.94 | x | 104.39 | | 0.53 | x | 0.7 | = | 78.91 | (79) |
| Southwest 0.9x | 0.77 | x | 2.94 | x | 92.85 | | 0.53 | x | 0.7 | = | 70.19 | (79) |
| Southwest 0.9x | 0.77 | x | 2.94 | x | 69.27 | | 0.53 | x | 0.7 | = | 52.36 | (79) |
| Southwest 0.9x | 0.77 | x | 2.94 | x | 44.07 | | 0.53 | x | 0.7 | = | 33.31 | (79) |
| Southwest 0.9x | 0.77 | x | 2.94 | x | 31.49 | | 0.53 | x | 0.7 | = | 23.8 | (79) |
| Northwest 0.9x | 0.77 | x | 26.58 | x | 11.28 | x | 0.53 | x | 0.7 | = | 77.11 | (81) |
| Northwest 0.9x | 0.77 | x | 26.58 | x | 22.97 | x | 0.53 | x | 0.7 | = | 156.95 | (81) |
| Northwest 0.9x | 0.77 | x | 26.58 | x | 41.38 | x | 0.53 | x | 0.7 | = | 282.77 | (81) |
| Northwest 0.9x | 0.77 | x | 26.58 | x | 67.96 | x | 0.53 | x | 0.7 | = | 464.4 | (81) |
| Northwest 0.9x | 0.77 | x | 26.58 | x | 91.35 | x | 0.53 | x | 0.7 | = | 624.24 | (81) |
| Northwest 0.9x | 0.77 | x | 26.58 | x | 97.38 | x | 0.53 | x | 0.7 | = | 665.51 | (81) |
| Northwest 0.9x | 0.77 | x | 26.58 | x | 91.1 | x | 0.53 | x | 0.7 | = | 622.57 | (81) |
| Northwest 0.9x | 0.77 | x | 26.58 | x | 72.63 | x | 0.53 | x | 0.7 | = | 496.32 | (81) |
| Northwest 0.9x | 0.77 | x | 26.58 | x | 50.42 | x | 0.53 | x | 0.7 | = | 344.56 | (81) |
| Northwest 0.9x | 0.77 | x | 26.58 | x | 28.07 | x | 0.53 | x | 0.7 | = | 191.81 | (81) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 26.58 | x | 14.2 | x | 0.53 | x | 0.7 | = | 97.02 | (81) |
| Northwest 0.9x | 0.77 | x | 26.58 | x | 9.21 | x | 0.53 | x | 0.7 | = | 62.97 | (81) |
| Rooflights 0.9x | 1 | x | 9.79 | x | 26 | x | 0.53 | x | 0.8 | = | 97.13 | (82) |
| Rooflights 0.9x | 1 | x | 9.79 | x | 54 | x | 0.53 | x | 0.8 | = | 201.74 | (82) |
| Rooflights 0.9x | 1 | x | 9.79 | x | 96 | x | 0.53 | x | 0.8 | = | 358.64 | (82) |
| Rooflights 0.9x | 1 | x | 9.79 | x | 150 | x | 0.53 | x | 0.8 | = | 560.38 | (82) |
| Rooflights 0.9x | 1 | x | 9.79 | x | 192 | x | 0.53 | x | 0.8 | = | 717.29 | (82) |
| Rooflights 0.9x | 1 | x | 9.79 | x | 200 | x | 0.53 | x | 0.8 | = | 747.17 | (82) |
| Rooflights 0.9x | 1 | x | 9.79 | x | 189 | x | 0.53 | x | 0.8 | = | 706.08 | (82) |
| Rooflights 0.9x | 1 | x | 9.79 | x | 157 | x | 0.53 | x | 0.8 | = | 586.53 | (82) |
| Rooflights 0.9x | 1 | x | 9.79 | x | 115 | x | 0.53 | x | 0.8 | = | 429.62 | (82) |
| Rooflights 0.9x | 1 | x | 9.79 | x | 66 | x | 0.53 | x | 0.8 | = | 246.57 | (82) |
| Rooflights 0.9x | 1 | x | 9.79 | x | 33 | x | 0.53 | x | 0.8 | = | 123.28 | (82) |
| Rooflights 0.9x | 1 | x | 9.79 | x | 21 | x | 0.53 | x | 0.8 | = | 78.45 | (82) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 430.79 | 795.69 | 1239.34 | 1765.63 | 2171.34 | 2236.5 | 2122.89 | 1810.72 | 1421.61 | 921.35 | 527.59 | 360.97 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 933.68 | 1296.3 | 1721.87 | 2218.56 | 2593.45 | 2629.45 | 2497.25 | 2191.72 | 1818.11 | 1347.68 | 988.27 | 848.15 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.99 | 0.96 | 0.91 | 0.8 | 0.65 | 0.49 | 0.37 | 0.43 | 0.67 | 0.9 | 0.97 | 0.99 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 18.67 | 19.06 | 19.64 | 20.27 | 20.7 | 20.9 | 20.97 | 20.95 | 20.76 | 20.1 | 19.24 | 18.59 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.71 | 19.71 | 19.71 | 19.72 | 19.72 | 19.72 | 19.72 | 19.73 | 19.72 | 19.72 | 19.72 | 19.72 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.98 | 0.96 | 0.9 | 0.77 | 0.58 | 0.4 | 0.27 | 0.32 | 0.58 | 0.87 | 0.97 | 0.99 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 16.64 | 17.21 | 18.03 | 18.9 | 19.43 | 19.66 | 19.71 | 19.7 | 19.52 | 18.7 | 17.48 | 16.53 | (90) |

fLA = Living area ÷ (4) = 0.34 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.33 | 17.84 | 18.58 | 19.36 | 19.86 | 20.08 | 20.14 | 20.13 | 19.94 | 19.17 | 18.07 | 17.23 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.33 | 17.84 | 18.58 | 19.36 | 19.86 | 20.08 | 20.14 | 20.13 | 19.94 | 19.17 | 18.07 | 17.23 | (93) |

## 8. Space heating requirement

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

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

Utilisation factor for gains, hm:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (94)m= | 0.97 | 0.94 | 0.88 | 0.75 | 0.59 | 0.43 | 0.3 | 0.36 | 0.6 | 0.85 | 0.95 | 0.98 | (94) |

# DER WorkSheet: New dwelling design stage

Useful gains, hmGm , W = (94)m x (84)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 908.3 | 1218.87 | 1506.81 | 1670.72 | 1533.62 | 1119.65 | 749.11 | 778.06 | 1089.21 | 1144.56 | 941.8 | 829.95 |

(95)

Monthly average external temperature from Table 8

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 |

(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ]

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (97)m= | 2857.26 | 2834.68 | 2642.62 | 2278.75 | 1776.16 | 1187.43 | 766.49 | 806.56 | 1267.87 | 1865.55 | 2392.03 | 2845.6 |

(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 1450.03 | 1085.82 | 845.04 | 437.78 | 180.45 | 0 | 0 | 0 | 0 | 536.42 | 1044.17 | 1499.64 |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 7079.35 (98)

Space heating requirement in kWh/m²/year 47.42 (99)

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

**Space heating:**

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 93.2 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 1450.03 | 1085.82 | 845.04 | 437.78 | 180.45 | 0 | 0 | 0 | 0 | 536.42 | 1044.17 | 1499.64 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 1555.83 | 1165.04 | 906.7 | 469.72 | 193.61 | 0 | 0 | 0 | 0 | 575.56 | 1120.35 | 1609.06 | (211) |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 7595.87 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 195.95 | 172.12 | 179.36 | 158.84 | 154.24 | 135.78 | 128.48 | 143.65 | 144.24 | 164.8 | 176.71 | 190.58 |

Efficiency of water heater 87.3 (216)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 89.84 | 89.79 | 89.68 | 89.41 | 88.84 | 87.3 | 87.3 | 87.3 | 87.3 | 89.5 | 89.77 | 89.86 |

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 218.1 | 191.68 | 200 | 177.66 | 173.61 | 155.53 | 147.17 | 164.55 | 165.22 | 184.14 | 196.85 | 212.08 |

Total = Sum(219a)$_{1...12}$ = 2186.57 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 7595.87 |
| Water heating fuel used | | 2186.57 |
| Electricity for pumps, fans and electric keep-hot | | |
| central heating pump: | 30 | (230c) |

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| boiler with a fan-assisted flue | | 45 | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | 75 | (231) |
| Electricity for lighting | | 503.44 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | Energy kWh/year | | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | | 0.216 | = | 1640.71 | (261) |
| Space heating (secondary) | (215) x | | 0.519 | = | 0 | (263) |
| Water heating | (219) x | | 0.216 | = | 472.3 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 2113.01 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | | 0.519 | = | 261.29 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | | 2413.22 | (272) |
| **Dwelling CO2 Emission Rate** | | (272) ÷ (4) = | | | 16.16 | (273) |
| EI rating (section 14) | | | | | 83 | (274) |