# SAP WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Natalie Wheeler | **Stroma Number:** | STRO027778 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.6 |

Property Address: Be Clean-Flat 13 - 3rd floor

**Address :** Flat 13, Hampshire street

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 79.33 | (1a) | x | 2.4 | (2a) | = | 190.39 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 79.33 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | | 190.39 | (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 | | | | | | | 2 | x 10 = | 20 | (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) = | 20 | ÷ (5) = | 0.11 | (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 | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.36 | (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) = | 0.3 | (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 |
| 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 |

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.38 | 0.38 | 0.37 | 0.33 | 0.32 | 0.29 | 0.29 | 0.28 | 0.3 | 0.32 | 0.34 | 0.35 |

*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= | 0.57 | 0.57 | 0.57 | 0.56 | 0.55 | 0.54 | 0.54 | 0.54 | 0.55 | 0.55 | 0.56 | 0.56 | (24d) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.57 | 0.57 | 0.57 | 0.56 | 0.55 | 0.54 | 0.54 | 0.54 | 0.55 | 0.55 | 0.56 | 0.56 | (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 | | | 1.87 | x | 1 | = | 1.87 | | | (26) |
| Windows Type 1 | | | 5.04 | x1/[1/( 1.4 )+ 0.04] | | = | 6.68 | | | (27) |
| Windows Type 2 | | | 4.96 | x1/[1/( 1.4 )+ 0.04] | | = | 6.58 | | | (27) |
| Windows Type 3 | | | 2.3 | x1/[1/( 1.4 )+ 0.04] | | = | 3.05 | | | (27) |
| Windows Type 4 | | | 2.3 | x1/[1/( 1.4 )+ 0.04] | | = | 3.05 | | | (27) |
| Walls | 78.1 | 16.47 | 61.63 | x | 0.18 | = | 11.09 | | | (29) |
| Roof | 79.33 | 0 | 79.33 | x | 0.11 | = | 8.73 | | | (30) |
| Total area of elements, m² | | | 157.43 | | | | | | | (31) |
| Party wall | | | 24.1 | x | 0 | = | 0 | | | (32) |
| Party floor | | | 79.33 | | | | | | | (32a) |

** 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) = 41.05 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (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 13.13 (36)

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

Total fabric heat loss (33) + (36) = 54.17 (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= | 36.07 | 35.89 | 35.71 | 34.88 | 34.72 | 34 | 34 | 33.86 | 34.28 | 34.72 | 35.04 | 35.36 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 90.24 | 90.06 | 89.88 | 89.05 | 88.89 | 88.17 | 88.17 | 88.04 | 88.45 | 88.89 | 89.21 | 89.54 | |

Average = $Sum(39)_{1...12}$ /12= 89.05 (39)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.14 | 1.14 | 1.13 | 1.12 | 1.12 | 1.11 | 1.11 | 1.11 | 1.11 | 1.12 | 1.12 | 1.13 |

Average = $Sum(40)_{1...12}$ /12= 1.12 (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 2.45 (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 92.39 (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= | 101.63 | 97.93 | 94.24 | 90.54 | 86.84 | 83.15 | 83.15 | 86.84 | 90.54 | 94.24 | 97.93 | 101.63 |

Total = $Sum(44)_{1...12}$ = 1108.66 (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= | 150.71 | 131.81 | 136.02 | 118.58 | 113.78 | 98.19 | 90.98 | 104.41 | 105.65 | 123.13 | 134.4 | 145.95 |

Total = $Sum(45)_{1...12}$ = 1453.62 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 22.61 | 19.77 | 20.4 | 17.79 | 17.07 | 14.73 | 13.65 | 15.66 | 15.85 | 18.47 | 20.16 | 21.89 | (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:

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= | 50.96 | 45.08 | 48.02 | 44.65 | 44.26 | 41.01 | 42.37 | 44.26 | 44.65 | 48.02 | 48.29 | 50.96 | (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= | 201.67 | 176.89 | 184.04 | 163.23 | 158.04 | 139.19 | 133.36 | 148.66 | 150.3 | 171.15 | 182.7 | 196.91 | (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) |
| WWHRS | -47.53 | -41.82 | -42.69 | -35.13 | -32.63 | -26.92 | -22.79 | -27.59 | -28.39 | -35.09 | -40.64 | -45.94 | (63) (G10) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 154.13 | 135.06 | 141.35 | 128.1 | 125.41 | 112.27 | 110.56 | 121.07 | 121.91 | 136.06 | 142.06 | 150.97 | |

Output from water heater (annual)$_{1...12}$ | 1578.97 | (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= | 62.85 | 55.1 | 57.23 | 50.59 | 48.9 | 42.9 | 40.85 | 45.78 | 46.29 | 52.95 | 56.76 | 61.27 | (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= | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 48.72 | 43.28 | 35.19 | 26.64 | 19.92 | 16.81 | 18.17 | 23.62 | 31.7 | 40.25 | 46.97 | 50.08 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 325.42 | 328.8 | 320.29 | 302.18 | 279.31 | 257.81 | 243.46 | 240.08 | 248.59 | 266.7 | 289.57 | 311.07 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 52.15 | 52.15 | 52.15 | 52.15 | 52.15 | 52.15 | 52.15 | 52.15 | 52.15 | 52.15 | 52.15 | 52.15 | (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= | -98 | -98 | -98 | -98 | -98 | -98 | -98 | -98 | -98 | -98 | -98 | -98 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 84.48 | 81.99 | 76.92 | 70.27 | 65.72 | 59.58 | 54.9 | 61.53 | 64.29 | 71.16 | 78.84 | 82.35 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 562.77 | 558.22 | 536.56 | 503.24 | 469.1 | 438.36 | 420.68 | 429.38 | 448.73 | 482.27 | 519.54 | 547.65 | (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 | 2.3 | x | 36.79 | x | 0.35 | x | 0.8 | = | 16.42 | (77) |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 2.3 | x | 62.67 | x | 0.35 | x | 0.8 | = | 27.97 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.3 | x | 85.75 | x | 0.35 | x | 0.8 | = | 38.27 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.3 | x | 106.25 | x | 0.35 | x | 0.8 | = | 47.42 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.3 | x | 119.01 | x | 0.35 | x | 0.8 | = | 53.11 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.3 | x | 118.15 | x | 0.35 | x | 0.8 | = | 52.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.3 | x | 113.91 | x | 0.35 | x | 0.8 | = | 50.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.3 | x | 104.39 | x | 0.35 | x | 0.8 | = | 46.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.3 | x | 92.85 | x | 0.35 | x | 0.8 | = | 41.44 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.3 | x | 69.27 | x | 0.35 | x | 0.8 | = | 30.91 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.3 | x | 44.07 | x | 0.35 | x | 0.8 | = | 19.67 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.3 | x | 31.49 | x | 0.35 | x | 0.8 | = | 14.05 | (77) |
| Southwest | 0.9x | 0.77 | x | 2.3 | x | 36.79 | | 0.35 | x | 0.8 | = | 16.42 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.3 | x | 62.67 | | 0.35 | x | 0.8 | = | 27.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.3 | x | 85.75 | | 0.35 | x | 0.8 | = | 38.27 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.3 | x | 106.25 | | 0.35 | x | 0.8 | = | 47.42 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.3 | x | 119.01 | | 0.35 | x | 0.8 | = | 53.11 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.3 | x | 118.15 | | 0.35 | x | 0.8 | = | 52.73 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.3 | x | 113.91 | | 0.35 | x | 0.8 | = | 50.84 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.3 | x | 104.39 | | 0.35 | x | 0.8 | = | 46.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.3 | x | 92.85 | | 0.35 | x | 0.8 | = | 41.44 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.3 | x | 69.27 | | 0.35 | x | 0.8 | = | 30.91 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.3 | x | 44.07 | | 0.35 | x | 0.8 | = | 19.67 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.3 | x | 31.49 | | 0.35 | x | 0.8 | = | 14.05 | (79) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 11.28 | x | 0.35 | x | 0.8 | = | 11.03 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.96 | x | 11.28 | x | 0.35 | x | 0.8 | = | 10.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 22.97 | x | 0.35 | x | 0.8 | = | 22.46 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.96 | x | 22.97 | x | 0.35 | x | 0.8 | = | 22.1 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 41.38 | x | 0.35 | x | 0.8 | = | 40.47 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.96 | x | 41.38 | x | 0.35 | x | 0.8 | = | 39.82 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 67.96 | x | 0.35 | x | 0.8 | = | 66.46 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.96 | x | 67.96 | x | 0.35 | x | 0.8 | = | 65.4 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 91.35 | x | 0.35 | x | 0.8 | = | 89.33 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.96 | x | 91.35 | x | 0.35 | x | 0.8 | = | 87.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 97.38 | x | 0.35 | x | 0.8 | = | 95.24 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.96 | x | 97.38 | x | 0.35 | x | 0.8 | = | 93.73 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 91.1 | x | 0.35 | x | 0.8 | = | 89.09 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.96 | x | 91.1 | x | 0.35 | x | 0.8 | = | 87.68 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 72.63 | x | 0.35 | x | 0.8 | = | 71.03 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.96 | x | 72.63 | x | 0.35 | x | 0.8 | = | 69.9 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 50.42 | x | 0.35 | x | 0.8 | = | 49.31 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.96 | x | 50.42 | x | 0.35 | x | 0.8 | = | 48.53 | (81) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 5.04 | x | 28.07 | x | 0.35 | x | 0.8 | = | 27.45 | (81) |
| Northwest 0.9x | 0.77 | x | 4.96 | x | 28.07 | x | 0.35 | x | 0.8 | = | 27.01 | (81) |
| Northwest 0.9x | 0.77 | x | 5.04 | x | 14.2 | x | 0.35 | x | 0.8 | = | 13.88 | (81) |
| Northwest 0.9x | 0.77 | x | 4.96 | x | 14.2 | x | 0.35 | x | 0.8 | = | 13.66 | (81) |
| Northwest 0.9x | 0.77 | x | 5.04 | x | 9.21 | x | 0.35 | x | 0.8 | = | 9.01 | (81) |
| Northwest 0.9x | 0.77 | x | 4.96 | x | 9.21 | x | 0.35 | x | 0.8 | = | 8.87 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 54.73 | 100.51 | 156.83 | 226.7 | 283.47 | 294.42 | 278.45 | 234.1 | 180.71 | 116.29 | 66.88 | 45.98 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 617.51 | 658.72 | 693.39 | 729.94 | 752.57 | 732.78 | 699.12 | 663.48 | 629.45 | 598.56 | 586.42 | 593.63 | (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 | 0.99 | 0.98 | 0.95 | 0.87 | 0.71 | 0.54 | 0.59 | 0.82 | 0.96 | 0.99 | 0.99 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.94 | 20.05 | 20.26 | 20.54 | 20.8 | 20.95 | 20.99 | 20.98 | 20.89 | 20.58 | 20.21 | 19.91 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.97 | 19.97 | 19.97 | 19.98 | 19.98 | 19.99 | 19.99 | 19.99 | 19.99 | 19.98 | 19.98 | 19.98 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.99 | 0.99 | 0.97 | 0.93 | 0.83 | 0.62 | 0.42 | 0.47 | 0.75 | 0.94 | 0.98 | 0.99 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.58 | 18.74 | 19.04 | 19.45 | 19.79 | 19.96 | 19.99 | 19.99 | 19.9 | 19.51 | 18.98 | 18.54 | (90) |

fLA = Living area ÷ (4) = 0.32 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.01 | 19.16 | 19.43 | 19.8 | 20.11 | 20.27 | 20.3 | 20.3 | 20.22 | 19.85 | 19.37 | 18.98 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19.01 | 19.16 | 19.43 | 19.8 | 20.11 | 20.27 | 20.3 | 20.3 | 20.22 | 19.85 | 19.37 | 18.98 | (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= | 0.99 | 0.98 | 0.97 | 0.93 | 0.83 | 0.65 | 0.46 | 0.51 | 0.77 | 0.94 | 0.98 | 0.99 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 610.62 | 647.71 | 672.24 | 678.97 | 627.59 | 475.68 | 323.17 | 337.91 | 483.44 | 561.32 | 575.01 | 588.1 | (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= | 1327.19 | 1283.91 | 1161.9 | 970.32 | 747.25 | 500.05 | 326.62 | 343.51 | 540.87 | 822.28 | 1094.87 | 1323.13 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 533.13 | 427.53 | 364.31 | 209.77 | 89.03 | 0 | 0 | 0 | 0 | 194.16 | 374.3 | 546.86 | |

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| | | |
|---|---|---|
| Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 2739.08 | (98) |
| Space heating requirement in kWh/m²/year | 34.53 | (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 | | 89.5 | (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) | 533.13 | 427.53 | 364.31 | 209.77 | 89.03 | 0 | 0 | 0 | 0 | 194.16 | 374.3 | 546.86 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 595.68 | 477.68 | 407.05 | 234.38 | 99.47 | 0 | 0 | 0 | 0 | 216.93 | 418.21 | 611.01 | | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | | | | | | | | | | | | | 3060.42 | (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**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 154.13 | 135.06 | 141.35 | 128.1 | 125.41 | 112.27 | 110.56 | 121.07 | 121.91 | 136.06 | 142.06 | 150.97 | | |
| Efficiency of water heater | | | | | | | | | | | | | 89.5 | (216) |
| (217)m= | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 172.22 | 150.91 | 157.94 | 143.13 | 140.12 | 125.44 | 123.54 | 135.27 | 136.21 | 152.02 | 158.73 | 168.68 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 1764.21 | (219) |

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 3060.42 | |
| Water heating fuel used | | | 1764.21 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 344.18 | (232) |

## 10a. Fuel costs - individual heating systems:

| | **Fuel** kWh/year | **Fuel Price** (Table 12) | | **Fuel Cost** £/year | |
|---|---|---|---|---|---|
| Space heating - main system 1 | (211) x | 3.48 | x 0.01 = | 106.5 | (240) |

| | | | | | |
|---|---|---|---|---|---|
| Space heating - main system 2 | (213) x | 0 | x 0.01 = | 0 | (241) |
| Space heating - secondary | (215) x | 13.19 | x 0.01 = | 0 | (242) |
| Water heating cost (other fuel) | (219) | 3.48 | x 0.01 = | 61.39 | (247) |
| Pumps, fans and electric keep-hot | (231) | 13.19 | x 0.01 = | 9.89 | (249) |

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

| | | | | | |
|---|---|---|---|---|---|
| Energy for lighting | (232) | 13.19 | x 0.01 = | 45.4 | (250) |
| Additional standing charges (Table 12) | | | | 120 | (251) |

Appendix Q items: repeat lines (253) and (254) as needed

| | | | |
|---|---|---|---|
| **Total energy cost** | (245)...(247) + (250)…(254) = | 343.19 | (255) |

## 11a. SAP rating - individual heating systems

| | | | |
|---|---|---|---|
| Energy cost deflator (Table 12) | | 0.42 | (256) |
| Energy cost factor (ECF) | [(255) x (256)] ÷ [(4) + 45.0] = | 1.16 | (257) |
| **SAP rating (Section 12)** | | 83.83 | (258) |

## 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 | = | 661.05 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 381.07 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1042.12 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 178.63 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1259.68 | (272) |
| **CO2 emissions per m²** | | (272) ÷ (4) = | | 15.88 | (273) |
| EI rating (section 14) | | | | 86 | (274) |

## 13a. Primary Energy

| | **Energy** kWh/year | **Primary** factor | | **P. Energy** kWh/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 1.22 | = | 3733.71 | (261) |
| Space heating (secondary) | (215) x | 3.07 | = | 0 | (263) |
| Energy for water heating | (219) x | 1.22 | = | 2152.33 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 5886.05 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 3.07 | = | 230.25 | (267) |
| Electricity for lighting | (232) x | 0 | = | 1056.64 | (268) |
| ‘Total Primary Energy | | sum of (265)…(271) = | | 7172.94 | (272) |
| **Primary energy kWh/m²/year** | | (272) ÷ (4) = | | 90.42 | (273) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Natalie Wheeler | **Stroma Number:** | STRO027778 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.6 |

Property Address: Be Clean-Flat 13 - 3rd floor

**Address :** Flat 13, Hampshire street

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 79.33 | (1a) | x | 2.4 | (2a) | = | 190.39 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 79.33 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 190.39 | (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 | | | | | | | 2 | x 10 = | 20 | (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) = | 20 | ÷ (5) = | 0.11 | (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 | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.36 | (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) = | 0.3 | (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 |
| 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 |

# DER WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.38 | 0.38 | 0.37 | 0.33 | 0.32 | 0.29 | 0.29 | 0.28 | 0.3 | 0.32 | 0.34 | 0.35 |

*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= | 0.57 | 0.57 | 0.57 | 0.56 | 0.55 | 0.54 | 0.54 | 0.54 | 0.55 | 0.55 | 0.56 | 0.56 | (24d) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.57 | 0.57 | 0.57 | 0.56 | 0.55 | 0.54 | 0.54 | 0.54 | 0.55 | 0.55 | 0.56 | 0.56 | (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 | | | 1.87 | x | 1 | = | 1.87 | | | (26) |
| Windows Type 1 | | | 5.04 | x1/[1/( 1.4 )+ 0.04] | | = | 6.68 | | | (27) |
| Windows Type 2 | | | 4.96 | x1/[1/( 1.4 )+ 0.04] | | = | 6.58 | | | (27) |
| Windows Type 3 | | | 2.3 | x1/[1/( 1.4 )+ 0.04] | | = | 3.05 | | | (27) |
| Windows Type 4 | | | 2.3 | x1/[1/( 1.4 )+ 0.04] | | = | 3.05 | | | (27) |
| Walls | 78.1 | 16.47 | 61.63 | x | 0.18 | = | 11.09 | | | (29) |
| Roof | 79.33 | 0 | 79.33 | x | 0.11 | = | 8.73 | | | (30) |
| Total area of elements, m² | | | 157.43 | | | | | | | (31) |
| Party wall | | | 24.1 | x | 0 | = | 0 | | | (32) |
| Party floor | | | 79.33 | | | | | | | (32a) |

** 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) = 41.05 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (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 13.13 (36)

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

Total fabric heat loss (33) + (36) = 54.17 (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 |
|---|---|---|---|---|---|---|---|---|---|---|---|

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 36.07 | 35.89 | 35.71 | 34.88 | 34.72 | 34 | 34 | 33.86 | 34.28 | 34.72 | 35.04 | 35.36 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 90.24 | 90.06 | 89.88 | 89.05 | 88.89 | 88.17 | 88.17 | 88.04 | 88.45 | 88.89 | 89.21 | 89.54 | |

Average = Sum(39)1…12 /12= 89.05 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.14 | 1.14 | 1.13 | 1.12 | 1.12 | 1.11 | 1.11 | 1.11 | 1.11 | 1.12 | 1.12 | 1.13 | |

Average = Sum(40)1…12 /12= 1.12 (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 2.45 (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 92.39 (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= | 101.63 | 97.93 | 94.24 | 90.54 | 86.84 | 83.15 | 83.15 | 86.84 | 90.54 | 94.24 | 97.93 | 101.63 | |

Total = Sum(44)1…12 = 1108.66 (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= | 150.71 | 131.81 | 136.02 | 118.58 | 113.78 | 98.19 | 90.98 | 104.41 | 105.65 | 123.13 | 134.4 | 145.95 | |

Total = Sum(45)1…12 = 1453.62 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 22.61 | 19.77 | 20.4 | 17.79 | 17.07 | 14.73 | 13.65 | 15.66 | 15.85 | 18.47 | 20.16 | 21.89 | (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:

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= | 50.96 | 45.08 | 48.02 | 44.65 | 44.26 | 41.01 | 42.37 | 44.26 | 44.65 | 48.02 | 48.29 | 50.96 | (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= | 201.67 | 176.89 | 184.04 | 163.23 | 158.04 | 139.19 | 133.36 | 148.66 | 150.3 | 171.15 | 182.7 | 196.91 | (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) |
| WWHRS | -47.53 | -41.82 | -42.69 | -35.13 | -32.63 | -26.92 | -22.79 | -27.59 | -28.39 | -35.09 | -40.64 | -45.94 | (63) (G10) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 154.13 | 135.06 | 141.35 | 128.1 | 125.41 | 112.27 | 110.56 | 121.07 | 121.91 | 136.06 | 142.06 | 150.97 | |

Output from water heater (annual)$_{1...12}$ | 1578.97 | (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= | 62.85 | 55.1 | 57.23 | 50.59 | 48.9 | 42.9 | 40.85 | 45.78 | 46.29 | 52.95 | 56.76 | 61.27 | (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= | 122.5 | 122.5 | 122.5 | 122.5 | 122.5 | 122.5 | 122.5 | 122.5 | 122.5 | 122.5 | 122.5 | 122.5 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 19.49 | 17.31 | 14.08 | 10.66 | 7.97 | 6.73 | 7.27 | 9.45 | 12.68 | 16.1 | 18.79 | 20.03 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 218.03 | 220.3 | 214.6 | 202.46 | 187.14 | 172.74 | 163.12 | 160.85 | 166.55 | 178.69 | 194.01 | 208.41 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.25 | 35.25 | 35.25 | 35.25 | 35.25 | 35.25 | 35.25 | 35.25 | 35.25 | 35.25 | 35.25 | 35.25 | (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= | -98 | -98 | -98 | -98 | -98 | -98 | -98 | -98 | -98 | -98 | -98 | -98 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 84.48 | 81.99 | 76.92 | 70.27 | 65.72 | 59.58 | 54.9 | 61.53 | 64.29 | 71.16 | 78.84 | 82.35 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 384.75 | 382.35 | 368.35 | 346.13 | 323.57 | 301.79 | 288.03 | 294.58 | 306.28 | 328.71 | 354.39 | 373.55 | (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 | 2.3 | x | 36.79 | x | 0.35 | x | 0.8 | = | 16.42 | (77) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 2.3 | x | 62.67 | x | 0.35 | x | 0.8 | = | 27.97 | (77) |
| Southeast 0.9x | 0.77 | x | 2.3 | x | 85.75 | x | 0.35 | x | 0.8 | = | 38.27 | (77) |
| Southeast 0.9x | 0.77 | x | 2.3 | x | 106.25 | x | 0.35 | x | 0.8 | = | 47.42 | (77) |
| Southeast 0.9x | 0.77 | x | 2.3 | x | 119.01 | x | 0.35 | x | 0.8 | = | 53.11 | (77) |
| Southeast 0.9x | 0.77 | x | 2.3 | x | 118.15 | x | 0.35 | x | 0.8 | = | 52.73 | (77) |
| Southeast 0.9x | 0.77 | x | 2.3 | x | 113.91 | x | 0.35 | x | 0.8 | = | 50.84 | (77) |
| Southeast 0.9x | 0.77 | x | 2.3 | x | 104.39 | x | 0.35 | x | 0.8 | = | 46.59 | (77) |
| Southeast 0.9x | 0.77 | x | 2.3 | x | 92.85 | x | 0.35 | x | 0.8 | = | 41.44 | (77) |
| Southeast 0.9x | 0.77 | x | 2.3 | x | 69.27 | x | 0.35 | x | 0.8 | = | 30.91 | (77) |
| Southeast 0.9x | 0.77 | x | 2.3 | x | 44.07 | x | 0.35 | x | 0.8 | = | 19.67 | (77) |
| Southeast 0.9x | 0.77 | x | 2.3 | x | 31.49 | x | 0.35 | x | 0.8 | = | 14.05 | (77) |
| Southwest 0.9x | 0.77 | x | 2.3 | x | 36.79 | | 0.35 | x | 0.8 | = | 16.42 | (79) |
| Southwest 0.9x | 0.77 | x | 2.3 | x | 62.67 | | 0.35 | x | 0.8 | = | 27.97 | (79) |
| Southwest 0.9x | 0.77 | x | 2.3 | x | 85.75 | | 0.35 | x | 0.8 | = | 38.27 | (79) |
| Southwest 0.9x | 0.77 | x | 2.3 | x | 106.25 | | 0.35 | x | 0.8 | = | 47.42 | (79) |
| Southwest 0.9x | 0.77 | x | 2.3 | x | 119.01 | | 0.35 | x | 0.8 | = | 53.11 | (79) |
| Southwest 0.9x | 0.77 | x | 2.3 | x | 118.15 | | 0.35 | x | 0.8 | = | 52.73 | (79) |
| Southwest 0.9x | 0.77 | x | 2.3 | x | 113.91 | | 0.35 | x | 0.8 | = | 50.84 | (79) |
| Southwest 0.9x | 0.77 | x | 2.3 | x | 104.39 | | 0.35 | x | 0.8 | = | 46.59 | (79) |
| Southwest 0.9x | 0.77 | x | 2.3 | x | 92.85 | | 0.35 | x | 0.8 | = | 41.44 | (79) |
| Southwest 0.9x | 0.77 | x | 2.3 | x | 69.27 | | 0.35 | x | 0.8 | = | 30.91 | (79) |
| Southwest 0.9x | 0.77 | x | 2.3 | x | 44.07 | | 0.35 | x | 0.8 | = | 19.67 | (79) |
| Southwest 0.9x | 0.77 | x | 2.3 | x | 31.49 | | 0.35 | x | 0.8 | = | 14.05 | (79) |
| Northwest 0.9x | 0.77 | x | 5.04 | x | 11.28 | x | 0.35 | x | 0.8 | = | 11.03 | (81) |
| Northwest 0.9x | 0.77 | x | 4.96 | x | 11.28 | x | 0.35 | x | 0.8 | = | 10.86 | (81) |
| Northwest 0.9x | 0.77 | x | 5.04 | x | 22.97 | x | 0.35 | x | 0.8 | = | 22.46 | (81) |
| Northwest 0.9x | 0.77 | x | 4.96 | x | 22.97 | x | 0.35 | x | 0.8 | = | 22.1 | (81) |
| Northwest 0.9x | 0.77 | x | 5.04 | x | 41.38 | x | 0.35 | x | 0.8 | = | 40.47 | (81) |
| Northwest 0.9x | 0.77 | x | 4.96 | x | 41.38 | x | 0.35 | x | 0.8 | = | 39.82 | (81) |
| Northwest 0.9x | 0.77 | x | 5.04 | x | 67.96 | x | 0.35 | x | 0.8 | = | 66.46 | (81) |
| Northwest 0.9x | 0.77 | x | 4.96 | x | 67.96 | x | 0.35 | x | 0.8 | = | 65.4 | (81) |
| Northwest 0.9x | 0.77 | x | 5.04 | x | 91.35 | x | 0.35 | x | 0.8 | = | 89.33 | (81) |
| Northwest 0.9x | 0.77 | x | 4.96 | x | 91.35 | x | 0.35 | x | 0.8 | = | 87.91 | (81) |
| Northwest 0.9x | 0.77 | x | 5.04 | x | 97.38 | x | 0.35 | x | 0.8 | = | 95.24 | (81) |
| Northwest 0.9x | 0.77 | x | 4.96 | x | 97.38 | x | 0.35 | x | 0.8 | = | 93.73 | (81) |
| Northwest 0.9x | 0.77 | x | 5.04 | x | 91.1 | x | 0.35 | x | 0.8 | = | 89.09 | (81) |
| Northwest 0.9x | 0.77 | x | 4.96 | x | 91.1 | x | 0.35 | x | 0.8 | = | 87.68 | (81) |
| Northwest 0.9x | 0.77 | x | 5.04 | x | 72.63 | x | 0.35 | x | 0.8 | = | 71.03 | (81) |
| Northwest 0.9x | 0.77 | x | 4.96 | x | 72.63 | x | 0.35 | x | 0.8 | = | 69.9 | (81) |
| Northwest 0.9x | 0.77 | x | 5.04 | x | 50.42 | x | 0.35 | x | 0.8 | = | 49.31 | (81) |
| Northwest 0.9x | 0.77 | x | 4.96 | x | 50.42 | x | 0.35 | x | 0.8 | = | 48.53 | (81) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 28.07 | x | 0.35 | x | 0.8 | = | 27.45 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.96 | x | 28.07 | x | 0.35 | x | 0.8 | = | 27.01 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 14.2 | x | 0.35 | x | 0.8 | = | 13.88 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.96 | x | 14.2 | x | 0.35 | x | 0.8 | = | 13.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 9.21 | x | 0.35 | x | 0.8 | = | 9.01 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.96 | x | 9.21 | x | 0.35 | x | 0.8 | = | 8.87 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 54.73 | 100.51 | 156.83 | 226.7 | 283.47 | 294.42 | 278.45 | 234.1 | 180.71 | 116.29 | 66.88 | 45.98 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 439.49 | 482.85 | 525.18 | 572.83 | 607.05 | 596.22 | 566.48 | 528.68 | 486.99 | 444.99 | 421.28 | 419.53 | (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= | 1 | 1 | 0.99 | 0.98 | 0.94 | 0.81 | 0.65 | 0.71 | 0.92 | 0.99 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.73 | 19.85 | 20.07 | 20.39 | 20.69 | 20.91 | 20.98 | 20.96 | 20.8 | 20.42 | 20.02 | 19.71 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.97 | 19.97 | 19.97 | 19.98 | 19.98 | 19.99 | 19.99 | 19.99 | 19.99 | 19.98 | 19.98 | 19.98 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.97 | 0.91 | 0.73 | 0.52 | 0.58 | 0.86 | 0.98 | 1 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.28 | 18.45 | 18.77 | 19.23 | 19.66 | 19.92 | 19.98 | 19.98 | 19.81 | 19.29 | 18.71 | 18.25 | (90) |

fLA = Living area ÷ (4) = 0.32 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.74 | 18.89 | 19.18 | 19.6 | 19.99 | 20.23 | 20.3 | 20.29 | 20.13 | 19.65 | 19.13 | 18.71 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.74 | 18.89 | 19.18 | 19.6 | 19.99 | 20.23 | 20.3 | 20.29 | 20.13 | 19.65 | 19.13 | 18.71 | (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= | 1 | 1 | 0.99 | 0.97 | 0.91 | 0.75 | 0.56 | 0.62 | 0.87 | 0.98 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 438.3 | 480.56 | 519.63 | 555.2 | 550.07 | 448.9 | 317.7 | 328.67 | 425.07 | 435.2 | 419.13 | 418.64 | (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= | 1302.66 | 1260.08 | 1140.05 | 952.69 | 736.54 | 496.66 | 325.93 | 342.36 | 533.09 | 804.36 | 1072.8 | 1299.18 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 643.08 | 523.83 | 461.59 | 286.19 | 138.74 | 0 | 0 | 0 | 0 | 274.65 | 470.64 | 655.12 | |

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| | | |
|---|---|---|
| Total per year (kWh/year) = Sum(98)1...5,9...12 = | 3453.85 | (98) |
| Space heating requirement in kWh/m²/year | 43.54 | (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 | | 89.5 | (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) | 643.08 | 523.83 | 461.59 | 286.19 | 138.74 | 0 | 0 | 0 | 0 | 274.65 | 470.64 | 655.12 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 718.53 | 585.29 | 515.74 | 319.77 | 155.01 | 0 | 0 | 0 | 0 | 306.88 | 525.86 | 731.98 | | (211) |
| Total (kWh/year) =Sum(211)1...5,10...12= | | | | | | | | | | | | | 3859.05 | (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**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 154.13 | 135.06 | 141.35 | 128.1 | 125.41 | 112.27 | 110.56 | 121.07 | 121.91 | 136.06 | 142.06 | 150.97 | | |
| Efficiency of water heater | | | | | | | | | | | | | 89.5 | (216) |
| (217)m= | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | 89.5 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 172.22 | 150.91 | 157.94 | 143.13 | 140.12 | 125.44 | 123.54 | 135.27 | 136.21 | 152.02 | 158.73 | 168.68 | | |
| Total = Sum(219a)1...12 = | | | | | | | | | | | | | 1764.21 | (219) |

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 3859.05 | |
| Water heating fuel used | | | 1764.21 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 344.18 | (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 | = | 833.55 | (261) |

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| | | | | | |
|---|---|---|---|---|---|
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 381.07 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1214.62 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 178.63 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1432.18 | (272) |
| **Dwelling CO2 Emission Rate** | | (272) ÷ (4) = | | 18.05 | (273) |
| EI rating (section 14) | | | | 85 | (274) |

# SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 18 May 2017

## Property Details: Be Clean-Flat 13 - 3rd floor

| | |
|---|---|
| **Dwelling type:** | Flat |
| **Located in:** | England |
| **Region:** | South East England |
| **Cross ventilation possible:** | Yes |
| **Number of storeys:** | 1 |
| **Front of dwelling faces:** | South West |
| **Overshading:** | Average or unknown |
| **Overhangs:** | None |
| **Thermal mass parameter:** | Indicative Value Medium |
| **Night ventilation:** | False |
| **Blinds, curtains, shutters:** | |
| **Ventilation rate during hot weather (ach):** | 3 ( Windows open half the time) |

## Overheating Details:

| | | |
|---|---|---|
| **Summer ventilation heat loss coefficient:** | 188.49 | **(P1)** |
| **Transmission heat loss coefficient:** | 54.2 | |
| **Summer heat loss coefficient:** | 242.66 | **(P2)** |

## Overhangs:

| **Orientation:** | **Ratio:** | **Z_overhangs:** |
|---|---|---|
| North West (Lounge terrace doors) | 0 | 1 |
| North West (Bedroom terrace doors) | 0 | 1 |
| South East (Bedroom) | 0 | 1 |
| South West (Bedroom) | 0 | 1 |

## Solar shading:

| **Orientation:** | **Z blinds:** | **Solar access:** | **Overhangs:** | **Z summer:** | |
|---|---|---|---|---|---|
| North West (Lounge terrace doors) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (Bedroom terrace doors) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South East (Bedroom) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South West (Bedroom) | 1 | 0.9 | 1 | 0.9 | **(P8)** |

## Solar gains:

| **Orientation** | | **Area** | **Flux** | **g_** | **FF** | **Shading** | **Gains** | |
|---|---|---|---|---|---|---|---|---|
| North West (Lounge terrace doors) | 0.9 x | 5.04 | 105.45 | 0.35 | 0.8 | 0.9 | 120.54 | |
| North West (Bedroom terrace doors) | 0.9 x | 4.96 | 105.45 | 0.35 | 0.8 | 0.9 | 118.63 | |
| South East (Bedroom) | 0.9 x | 2.3 | 126.97 | 0.35 | 0.8 | 0.9 | 66.23 | |
| South West (Bedroom) | 0.9 x | 2.3 | 126.97 | 0.35 | 0.8 | 0.9 | 66.23 | |
| | | | | | | **Total** | 371.63 | **(P3/P4)** |

## Internal gains:

| | **June** | **July** | **August** | |
|---|---|---|---|---|
| Internal gains | 435.36 | 417.68 | 426.38 | |
| Total summer gains | 832.83 | 789.31 | 741.79 | **(P5)** |
| Summer gain/loss ratio | 3.43 | 3.25 | 3.06 | **(P6)** |
| Mean summer external temperature (South East England) | 15.4 | 17.4 | 17.5 | |
| Thermal mass temperature increment | 0.25 | 0.25 | 0.25 | |
| Threshold temperature | 19.08 | 20.9 | 20.81 | **(P7)** |
| **Likelihood of high internal temperature** | **Not significant** | **Slight** | **Slight** | |

# SAP 2012 Overheating Assessment

**Assessment of likelihood of high internal temperature:** Slight