# SAP WorkSheet: New dwelling design stage

compliance testing consulting
build energy

## User Details:

| | | | |
|---|---|---|---|
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| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.3.15 |

## Property Address: Unit 1 (GF&FF END) CLEAN

**Address :** New Dwelling at:, Gordon House, 6 Lissenden Gardens, LONDON, NW5 1LX

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 73.62 (1a) | x | 2.4 (2a) | = | 176.69 | (3a) |
| First floor | 64.14 (1b) | x | 3.32 (2b) | = | 212.94 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 137.76 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 389.63 | (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) = | 0.05 | (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 | | | 4 | (17) |
| If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | | 0.25 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | | |
| Number of sides sheltered | | | 3 | (19) |
| Shelter factor | | (20) = 1 - [0.075 x (19)] = | 0.78 | (20) |
| Infiltration rate incorporating shelter factor | | (21) = (18) x (20) = | 0.19 | (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 |

# SAP WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.25 | 0.24 | 0.24 | 0.21 | 0.21 | 0.19 | 0.19 | 0.18 | 0.19 | 0.21 | 0.22 | 0.23 |

*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= | 0.53 | 0.53 | 0.53 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 | 0.53 |

(24d)

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

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

(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 | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 5.31 | x1/[1/( 1.4 )+ 0.04] = | 7.04 | | | (27) |
| Windows Type 2 | | | 8.12 | x1/[1/( 1.4 )+ 0.04] = | 10.77 | | | (27) |
| Windows Type 3 | | | 2.53 | x1/[1/( 1.4 )+ 0.04] = | 3.35 | | | (27) |
| Windows Type 4 | | | 2.53 | x1/[1/( 1.4 )+ 0.04] = | 3.35 | | | (27) |
| Windows Type 5 | | | 2.53 | x1/[1/( 1.4 )+ 0.04] = | 3.35 | | | (27) |
| Windows Type 6 | | | 2.53 | x1/[1/( 1.4 )+ 0.04] = | 3.35 | | | (27) |
| Windows Type 7 | | | 0.69 | x1/[1/( 1.4 )+ 0.04] = | 0.91 | | | (27) |
| Windows Type 8 | | | 1.27 | x1/[1/( 1.4 )+ 0.04] = | 1.68 | | | (27) |
| Windows Type 9 | | | 3.42 | x1/[1/( 1.4 )+ 0.04] = | 4.53 | | | (27) |
| Rooflights | | | 12.74 | x1/[1/(1.4) + 0.04] = | 17.836 | | | (27b) |
| Walls | 147.2 | 28.93 | 118.27 | x 0.16 = | 18.92 | | | (29) |
| Roof Type1 | 9.48 | 0 | 9.48 | x 0.14 = | 1.33 | | | (30) |
| Roof Type2 | 71.67 | 12.74 | 58.93 | x 0.14 = | 8.25 | | | (30) |
| Total area of elements, m² | | | 228.35 | | | | | (31) |
| Party wall | | | 37.15 | x 0 = | 0 | | | (32) |
| Party wall | | | 11.57 | x 0 = | 0 | | | (32) |

** 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) = 83.74 (33)

# SAP WorkSheet: New dwelling design stage

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 16.5 (36)

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

Total fabric heat loss (33) + (36) = 100.24 (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= | 68.25 | 68.1 | 67.95 | 67.24 | 67.11 | 66.49 | 66.49 | 66.38 | 66.73 | 67.11 | 67.38 | 67.66 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 168.49 | 168.34 | 168.19 | 167.48 | 167.35 | 166.73 | 166.73 | 166.62 | 166.97 | 167.35 | 167.62 | 167.9 | |

Average = Sum(39)$_{1...12}$ /12= 167.48 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.22 | 1.22 | 1.22 | 1.22 | 1.21 | 1.21 | 1.21 | 1.21 | 1.21 | 1.21 | 1.22 | 1.22 | |

Average = Sum(40)$_{1...12}$ /12= 1.22 (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 2.91 (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) + 36 103.38 (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= | 113.71 | 109.58 | 105.44 | 101.31 | 97.17 | 93.04 | 93.04 | 97.17 | 101.31 | 105.44 | 109.58 | 113.71 | |

Total = Sum(44)$_{1...12}$ = 1240.52 (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= | 168.63 | 147.49 | 152.2 | 132.69 | 127.32 | 109.86 | 101.81 | 116.82 | 118.22 | 137.77 | 150.39 | 163.31 | |

Total = Sum(45)$_{1...12}$ = 1626.52 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25.3 | 22.12 | 22.83 | 19.9 | 19.1 | 16.48 | 15.27 | 17.52 | 17.73 | 20.67 | 22.56 | 24.5 | (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:

# SAP WorkSheet: New dwelling design stage

| | | |
|---|---|---|
| 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 | 46.03 | 50.96 | 49.32 | 49.52 | 45.88 | 47.41 | 49.52 | 49.32 | 50.96 | 49.32 | 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= | 219.59 | 193.52 | 203.15 | 182 | 176.84 | 155.75 | 149.22 | 166.34 | 167.53 | 188.73 | 199.71 | 214.27 | (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) |
| FHRS | 55.84 | 40.78 | 31.2 | 16.65 | 10.33 | 8.06 | 7.72 | 8.7 | 8.75 | 23.4 | 40.95 | 56.3 | (63) (G2) |
| WWHRS | -55.17 | -48.54 | -49.54 | -40.75 | -37.83 | -31.2 | -26.4 | -31.97 | -32.9 | -40.69 | -47.14 | -53.33 | (63) (G10) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 106.75 | 102.54 | 120.58 | 122.82 | 126.89 | 114.83 | 113.39 | 123.89 | 124.11 | 122.81 | 109.84 | 102.81 | |

Output from water heater (annual)$_{1...12}$ 1391.27 (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= | 68.81 | 60.55 | 63.34 | 56.45 | 54.71 | 48 | 45.7 | 51.22 | 51.64 | 58.55 | 62.33 | 67.04 | (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= | 174.76 | 174.76 | 174.76 | 174.76 | 174.76 | 174.76 | 174.76 | 174.76 | 174.76 | 174.76 | 174.76 | 174.76 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 68.39 | 60.74 | 49.4 | 37.4 | 27.96 | 23.6 | 25.5 | 33.15 | 44.49 | 56.49 | 65.94 | 70.29 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 457.99 | 462.74 | 450.76 | 425.27 | 393.08 | 362.84 | 342.63 | 337.88 | 349.85 | 375.35 | 407.53 | 437.78 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 55.39 | 55.39 | 55.39 | 55.39 | 55.39 | 55.39 | 55.39 | 55.39 | 55.39 | 55.39 | 55.39 | 55.39 | (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= | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | (71) |

# SAP WorkSheet: New dwelling design stage

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 92.49 | 90.1 | 85.14 | 78.4 | 73.54 | 66.67 | 61.43 | 68.85 | 71.72 | 78.7 | 86.57 | 90.11 | (72) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 735.51 | 730.22 | 701.95 | 657.71 | 611.22 | 569.75 | 546.2 | 556.52 | 582.7 | 627.18 | 676.68 | 714.82 | (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) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast 0.9x | 0.77 | x | 2.53 | x | 11.28 | x | 0.76 | x | 0.7 | = | 10.52 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 11.28 | x | 0.76 | x | 0.7 | = | 10.52 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 11.28 | x | 0.76 | x | 0.7 | = | 10.52 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 11.28 | x | 0.76 | x | 0.7 | = | 10.52 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 22.97 | x | 0.76 | x | 0.7 | = | 21.42 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 22.97 | x | 0.76 | x | 0.7 | = | 21.42 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 22.97 | x | 0.76 | x | 0.7 | = | 21.42 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 22.97 | x | 0.76 | x | 0.7 | = | 21.42 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 41.38 | x | 0.76 | x | 0.7 | = | 38.6 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 41.38 | x | 0.76 | x | 0.7 | = | 38.6 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 41.38 | x | 0.76 | x | 0.7 | = | 38.6 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 41.38 | x | 0.76 | x | 0.7 | = | 38.6 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 67.96 | x | 0.76 | x | 0.7 | = | 63.39 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 67.96 | x | 0.76 | x | 0.7 | = | 63.39 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 67.96 | x | 0.76 | x | 0.7 | = | 63.39 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 67.96 | x | 0.76 | x | 0.7 | = | 63.39 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.35 | x | 0.76 | x | 0.7 | = | 85.2 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.35 | x | 0.76 | x | 0.7 | = | 85.2 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.35 | x | 0.76 | x | 0.7 | = | 85.2 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.35 | x | 0.76 | x | 0.7 | = | 85.2 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 97.38 | x | 0.76 | x | 0.7 | = | 90.84 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 97.38 | x | 0.76 | x | 0.7 | = | 90.84 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 97.38 | x | 0.76 | x | 0.7 | = | 90.84 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 97.38 | x | 0.76 | x | 0.7 | = | 90.84 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.1 | x | 0.76 | x | 0.7 | = | 84.97 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.1 | x | 0.76 | x | 0.7 | = | 84.97 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.1 | x | 0.76 | x | 0.7 | = | 84.97 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.1 | x | 0.76 | x | 0.7 | = | 84.97 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 72.63 | x | 0.76 | x | 0.7 | = | 67.74 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 72.63 | x | 0.76 | x | 0.7 | = | 67.74 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 72.63 | x | 0.76 | x | 0.7 | = | 67.74 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 72.63 | x | 0.76 | x | 0.7 | = | 67.74 | (75) |

# SAP WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 50.42 | x | 0.76 | x | 0.7 | = | 47.03 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 50.42 | x | 0.76 | x | 0.7 | = | 47.03 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 50.42 | x | 0.76 | x | 0.7 | = | 47.03 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 50.42 | x | 0.76 | x | 0.7 | = | 47.03 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 28.07 | x | 0.76 | x | 0.7 | = | 26.18 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 28.07 | x | 0.76 | x | 0.7 | = | 26.18 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 28.07 | x | 0.76 | x | 0.7 | = | 26.18 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 28.07 | x | 0.76 | x | 0.7 | = | 26.18 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 14.2 | x | 0.76 | x | 0.7 | = | 13.24 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 14.2 | x | 0.76 | x | 0.7 | = | 13.24 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 14.2 | x | 0.76 | x | 0.7 | = | 13.24 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 14.2 | x | 0.76 | x | 0.7 | = | 13.24 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 9.21 | x | 0.76 | x | 0.7 | = | 8.59 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 9.21 | x | 0.76 | x | 0.7 | = | 8.59 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 9.21 | x | 0.76 | x | 0.7 | = | 8.59 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 9.21 | x | 0.76 | x | 0.7 | = | 8.59 | (75) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 36.79 | | 0.76 | x | 0.7 | = | 72.03 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 36.79 | | 0.76 | x | 0.7 | = | 110.15 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 36.79 | | 0.76 | x | 0.7 | = | 46.39 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 62.67 | | 0.76 | x | 0.7 | = | 122.69 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 62.67 | | 0.76 | x | 0.7 | = | 187.62 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 62.67 | | 0.76 | x | 0.7 | = | 79.02 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 85.75 | | 0.76 | x | 0.7 | = | 167.88 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 85.75 | | 0.76 | x | 0.7 | = | 256.71 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 85.75 | | 0.76 | x | 0.7 | = | 108.12 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 106.25 | | 0.76 | x | 0.7 | = | 208.01 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 106.25 | | 0.76 | x | 0.7 | = | 318.08 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 106.25 | | 0.76 | x | 0.7 | = | 133.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 119.01 | | 0.76 | x | 0.7 | = | 232.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 119.01 | | 0.76 | x | 0.7 | = | 356.28 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 119.01 | | 0.76 | x | 0.7 | = | 150.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 118.15 | | 0.76 | x | 0.7 | = | 231.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 118.15 | | 0.76 | x | 0.7 | = | 353.7 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 118.15 | | 0.76 | x | 0.7 | = | 148.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 113.91 | | 0.76 | x | 0.7 | = | 223 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 113.91 | | 0.76 | x | 0.7 | = | 341 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 113.91 | | 0.76 | x | 0.7 | = | 143.62 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 104.39 | | 0.76 | x | 0.7 | = | 204.36 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 104.39 | | 0.76 | x | 0.7 | = | 312.51 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 104.39 | | 0.76 | x | 0.7 | = | 131.62 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 92.85 | | 0.76 | x | 0.7 | = | 181.77 | (79) |

# SAP WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 92.85 | | 0.76 | x | 0.7 | = | 277.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 92.85 | | 0.76 | x | 0.7 | = | 117.07 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 69.27 | | 0.76 | x | 0.7 | = | 135.6 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 69.27 | | 0.76 | x | 0.7 | = | 207.36 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 69.27 | | 0.76 | x | 0.7 | = | 87.34 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 44.07 | | 0.76 | x | 0.7 | = | 86.28 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 44.07 | | 0.76 | x | 0.7 | = | 131.93 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 44.07 | | 0.76 | x | 0.7 | = | 55.57 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 31.49 | | 0.76 | x | 0.7 | = | 61.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 31.49 | | 0.76 | x | 0.7 | = | 94.26 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 31.49 | | 0.76 | x | 0.7 | = | 39.7 | (79) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 11.28 | x | 0.76 | x | 0.7 | = | 2.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 11.28 | x | 0.76 | x | 0.7 | = | 5.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 22.97 | x | 0.76 | x | 0.7 | = | 5.84 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 22.97 | x | 0.76 | x | 0.7 | = | 10.75 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 41.38 | x | 0.76 | x | 0.7 | = | 10.53 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 41.38 | x | 0.76 | x | 0.7 | = | 19.37 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 67.96 | x | 0.76 | x | 0.7 | = | 17.29 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 67.96 | x | 0.76 | x | 0.7 | = | 31.82 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 91.35 | x | 0.76 | x | 0.7 | = | 23.24 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 91.35 | x | 0.76 | x | 0.7 | = | 42.77 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 97.38 | x | 0.76 | x | 0.7 | = | 24.77 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 97.38 | x | 0.76 | x | 0.7 | = | 45.6 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 91.1 | x | 0.76 | x | 0.7 | = | 23.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 91.1 | x | 0.76 | x | 0.7 | = | 42.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 72.63 | x | 0.76 | x | 0.7 | = | 18.48 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 72.63 | x | 0.76 | x | 0.7 | = | 34.01 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 50.42 | x | 0.76 | x | 0.7 | = | 12.83 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 50.42 | x | 0.76 | x | 0.7 | = | 23.61 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 28.07 | x | 0.76 | x | 0.7 | = | 7.14 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 28.07 | x | 0.76 | x | 0.7 | = | 13.14 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 14.2 | x | 0.76 | x | 0.7 | = | 3.61 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 14.2 | x | 0.76 | x | 0.7 | = | 6.65 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 9.21 | x | 0.76 | x | 0.7 | = | 2.34 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 9.21 | x | 0.76 | x | 0.7 | = | 4.31 | (81) |
| Rooflights | 0.9x | 1 | x | 12.74 | x | 20.24 | x | 0.76 | x | 0.7 | = | 123.44 | (82) |
| Rooflights | 0.9x | 1 | x | 12.74 | x | 40.55 | x | 0.76 | x | 0.7 | = | 247.33 | (82) |
| Rooflights | 0.9x | 1 | x | 12.74 | x | 74.78 | x | 0.76 | x | 0.7 | = | 456.16 | (82) |
| Rooflights | 0.9x | 1 | x | 12.74 | x | 130.19 | x | 0.76 | x | 0.7 | = | 794.13 | (82) |
| Rooflights | 0.9x | 1 | x | 12.74 | x | 183.82 | x | 0.76 | x | 0.7 | = | 1121.29 | (82) |
| Rooflights | 0.9x | 1 | x | 12.74 | x | 200.21 | x | 0.76 | x | 0.7 | = | 1221.24 | (82) |

# SAP WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rooflights 0.9x | 1 | x | 12.74 | x | 185.57 | x | 0.76 | x | 0.7 | = | 1131.99 | (82) |
| Rooflights 0.9x | 1 | x | 12.74 | x | 142.19 | x | 0.76 | x | 0.7 | = | 867.36 | (82) |
| Rooflights 0.9x | 1 | x | 12.74 | x | 93.09 | x | 0.76 | x | 0.7 | = | 567.83 | (82) |
| Rooflights 0.9x | 1 | x | 12.74 | x | 49.71 | x | 0.76 | x | 0.7 | = | 303.23 | (82) |
| Rooflights 0.9x | 1 | x | 12.74 | x | 25.27 | x | 0.76 | x | 0.7 | = | 154.14 | (82) |
| Rooflights 0.9x | 1 | x | 12.74 | x | 16.69 | x | 0.76 | x | 0.7 | = | 101.83 | (82) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 402.26 | 738.95 | 1173.16 | 1756.84 | 2267.43 | 2388.92 | 2245.34 | 1839.3 | 1369.2 | 858.54 | 491.14 | 338.48 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 1137.77 | 1469.18 | 1875.1 | 2414.54 | 2878.65 | 2958.67 | 2791.54 | 2395.82 | 1951.9 | 1485.72 | 1167.82 | 1053.3 | (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 | 0.97 | 0.92 | 0.75 | 0.53 | 0.36 | 0.26 | 0.32 | 0.57 | 0.89 | 0.98 | 0.99 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.87 | 20.14 | 20.51 | 20.85 | 20.97 | 21 | 21 | 21 | 20.97 | 20.71 | 20.2 | 19.81 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.9 | 19.9 | 19.9 | 19.91 | 19.91 | 19.91 | 19.91 | 19.91 | 19.91 | 19.91 | 19.91 | 19.91 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.99 | 0.97 | 0.89 | 0.7 | 0.47 | 0.3 | 0.2 | 0.24 | 0.49 | 0.85 | 0.97 | 0.99 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.42 | 18.81 | 19.33 | 19.76 | 19.89 | 19.91 | 19.91 | 19.91 | 19.89 | 19.61 | 18.91 | 18.34 | (90) |

fLA = Living area ÷ (4) = 0.47 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.09 | 19.43 | 19.88 | 20.27 | 20.39 | 20.42 | 20.42 | 20.42 | 20.4 | 20.13 | 19.51 | 19.02 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.94 | 19.28 | 19.73 | 20.12 | 20.24 | 20.27 | 20.27 | 20.27 | 20.25 | 19.98 | 19.36 | 18.87 | (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 | 0.96 | 0.89 | 0.71 | 0.49 | 0.32 | 0.22 | 0.27 | 0.51 | 0.85 | 0.97 | 0.99 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 1122.5 | 1413.24 | 1668.73 | 1716.12 | 1404.5 | 942.07 | 611.27 | 643.62 | 1003.77 | 1262.39 | 1133.19 | 1042.99 | (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= | 2467.4 | 2420.97 | 2225.72 | 1878.77 | 1429.76 | 944.68 | 611.58 | 644.45 | 1026.26 | 1569.01 | 2055.48 | 2463.1 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 1000.6 | 677.2 | 414.41 | 117.11 | 18.79 | 0 | 0 | 0 | 0 | 228.12 | 664.05 | 1056.56 | |

# SAP WorkSheet: New dwelling design stage

| | | |
|---|---|---|
| Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 4176.84 | (98) |
| Space heating requirement in kWh/m²/year | 30.32 | (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 | 90.4 | (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) | 1000.6 | 677.2 | 414.41 | 117.11 | 18.79 | 0 | 0 | 0 | 0 | 228.12 | 664.05 | 1056.56 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 1106.86 | 749.11 | 458.41 | 129.55 | 20.79 | 0 | 0 | 0 | 0 | 252.34 | 734.57 | 1168.76 | |

| | | |
|---|---|---|
| Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | 4620.4 | (211) |

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 106.75 | 102.54 | 120.58 | 122.82 | 126.89 | 114.83 | 113.39 | 123.89 | 124.11 | 122.81 | 109.84 | 102.81 |

| | | |
|---|---|---|
| Efficiency of water heater | 80.3 | (216) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 89.32 | 88.93 | 87.91 | 84.93 | 81.47 | 80.3 | 80.3 | 80.3 | 80.3 | 86.59 | 88.81 | 89.4 | (217) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 119.51 | 115.3 | 137.17 | 144.61 | 155.75 | 143.01 | 141.2 | 154.29 | 154.55 | 141.84 | 123.68 | 115 |

| | | |
|---|---|---|
| Total = Sum(219a)$_{1...12}$ = | 1645.9 | (219) |

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 4620.4 | |
| Water heating fuel used | | 1645.9 | |
| 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 | | 483.11 | (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 = | 160.79 | (240) |

# SAP WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| 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 = | 57.28 | (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 = | 63.72 | (250) |
| Additional standing charges (Table 12) | | | | 120 | (251) |
| | one of (233) to (235) x) | 13.19 | x 0.01 = | 0 | (252) |
| Appendix Q items: repeat lines (253) and (254) as needed | | | | | |
| **Total energy cost** | (245)...(247) + (250)…(254) = | | | 411.68 | (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] = | 0.95 | (257) |
| **SAP rating (Section 12)** | | 86.8 | (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 | = | 998.01 | (261) | |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) | |
| Water heating | (219) x | 0.216 | = | 355.52 | (264) | |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1353.52 | (265) | |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) | |
| Electricity for lighting | (232) x | 0.519 | = | 250.74 | (268) | |
| Energy saving/generation technologies | | | | | | |
| Total CO2, kg/year | sum of (265)…(271) = | | | 1643.18 | (272) | |
| **CO2 emissions per m²** | (272) ÷ (4) = | | | 11.93 | (273) | |
| EI rating (section 14) | | | | 88 | (274) | |

## 13a. Primary Energy

| | | **Energy** kWh/year | **Primary** factor | | **P. Energy** kWh/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 1.22 | = | 5636.88 | (261) | |
| Space heating (secondary) | (215) x | 3.07 | = | 0 | (263) | |
| Energy for water heating | (219) x | 1.22 | = | 2008 | (264) | |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 7644.89 | (265) | |
| Electricity for pumps, fans and electric keep-hot | (231) x | 3.07 | = | 230.25 | (267) | |
| Electricity for lighting | (232) x | 0 | = | 1483.16 | (268) | |

# SAP WorkSheet: New dwelling design stage

Energy saving/generation technologies

| | | | |
|---|---|---|---|
| ‘Total Primary Energy | sum of (265)…(271) = | 9358.3 | (272) |
| **Primary energy kWh/m²/year** | (272) ÷ (4) = | 67.93 | (273) |

# DER WorkSheet: New dwelling design stage

build energy — compliance testing consulting

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Peter Mitchell | **Stroma Number:** | STRO007945 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.3.15 |

## Property Address: Unit 1 (GF&FF END) CLEAN

**Address :** New Dwelling at:, Gordon House, 6 Lissenden Gardens, LONDON, NW5 1LX

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 73.62 | (1a) x | 2.4 | (2a) = | 176.69 | (3a) |
| First floor | 64.14 | (1b) x | 3.32 | (2b) = | 212.94 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 137.76 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 389.63 | (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) = | 0.05 (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 | | | 4 (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | 0.25 (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | | 3 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 0.78 (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | | 0.19 (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 |

# DER WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.25 | 0.24 | 0.24 | 0.21 | 0.21 | 0.19 | 0.19 | 0.18 | 0.19 | 0.21 | 0.22 | 0.23 |

*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= | 0.53 | 0.53 | 0.53 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 | 0.53 |

(24d)

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

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

(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 | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 5.31 | x1/[1/( 1.4 )+ 0.04] = | 7.04 | | | (27) |
| Windows Type 2 | | | 8.12 | x1/[1/( 1.4 )+ 0.04] = | 10.77 | | | (27) |
| Windows Type 3 | | | 2.53 | x1/[1/( 1.4 )+ 0.04] = | 3.35 | | | (27) |
| Windows Type 4 | | | 2.53 | x1/[1/( 1.4 )+ 0.04] = | 3.35 | | | (27) |
| Windows Type 5 | | | 2.53 | x1/[1/( 1.4 )+ 0.04] = | 3.35 | | | (27) |
| Windows Type 6 | | | 2.53 | x1/[1/( 1.4 )+ 0.04] = | 3.35 | | | (27) |
| Windows Type 7 | | | 0.69 | x1/[1/( 1.4 )+ 0.04] = | 0.91 | | | (27) |
| Windows Type 8 | | | 1.27 | x1/[1/( 1.4 )+ 0.04] = | 1.68 | | | (27) |
| Windows Type 9 | | | 3.42 | x1/[1/( 1.4 )+ 0.04] = | 4.53 | | | (27) |
| Rooflights | | | 12.74 | x1/[1/(1.4) + 0.04] = | 17.836 | | | (27b) |
| Walls | 147.2 | 28.93 | 118.27 | x 0.16 = | 18.92 | | | (29) |
| Roof Type1 | 9.48 | 0 | 9.48 | x 0.14 = | 1.33 | | | (30) |
| Roof Type2 | 71.67 | 12.74 | 58.93 | x 0.14 = | 8.25 | | | (30) |
| Total area of elements, m² | | | 228.35 | | | | | (31) |
| Party wall | | | 37.15 | x 0 = | 0 | | | (32) |
| Party wall | | | 11.57 | x 0 = | 0 | | | (32) |

** 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) = 83.74 (33)

# DER WorkSheet: New dwelling design stage

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 16.5 (36)

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

Total fabric heat loss (33) + (36) = 100.24 (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= | 68.25 | 68.1 | 67.95 | 67.24 | 67.11 | 66.49 | 66.49 | 66.38 | 66.73 | 67.11 | 67.38 | 67.66 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 168.49 | 168.34 | 168.19 | 167.48 | 167.35 | 166.73 | 166.73 | 166.62 | 166.97 | 167.35 | 167.62 | 167.9 | |

Average = Sum(39)$_{1...12}$ /12= 167.48 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.22 | 1.22 | 1.22 | 1.22 | 1.21 | 1.21 | 1.21 | 1.21 | 1.21 | 1.21 | 1.22 | 1.22 | |

Average = Sum(40)$_{1...12}$ /12= 1.22 (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 2.91 (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) + 36 103.38 (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= | 113.71 | 109.58 | 105.44 | 101.31 | 97.17 | 93.04 | 93.04 | 97.17 | 101.31 | 105.44 | 109.58 | 113.71 | |

Total = Sum(44)$_{1...12}$ = 1240.52 (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= | 168.63 | 147.49 | 152.2 | 132.69 | 127.32 | 109.86 | 101.81 | 116.82 | 118.22 | 137.77 | 150.39 | 163.31 | |

Total = Sum(45)$_{1...12}$ = 1626.52 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25.3 | 22.12 | 22.83 | 19.9 | 19.1 | 16.48 | 15.27 | 17.52 | 17.73 | 20.67 | 22.56 | 24.5 | (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:

# DER WorkSheet: New dwelling design stage

| | | |
|---|---|---|
| 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 | 46.03 | 50.96 | 49.32 | 49.52 | 45.88 | 47.41 | 49.52 | 49.32 | 50.96 | 49.32 | 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= | 219.59 | 193.52 | 203.15 | 182 | 176.84 | 155.75 | 149.22 | 166.34 | 167.53 | 188.73 | 199.71 | 214.27 | (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) |
| FHRS | 58.71 | 45.3 | 34.79 | 18.74 | 10.68 | 8.06 | 7.72 | 8.7 | 8.75 | 26.14 | 45.71 | 59.07 | (63) (G2) |
| WWHRS | -55.17 | -48.54 | -49.54 | -40.75 | -37.83 | -31.2 | -26.4 | -31.97 | -32.9 | -40.69 | -47.14 | -53.33 | (63) (G10) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 103.88 | 98.01 | 116.98 | 120.74 | 126.54 | 114.83 | 113.39 | 123.89 | 124.11 | 120.07 | 105.08 | 100.04 | |

Output from water heater (annual)$_{1...12}$ 1367.56 (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= | 68.81 | 60.55 | 63.34 | 56.45 | 54.71 | 48 | 45.7 | 51.22 | 51.64 | 58.55 | 62.33 | 67.04 | (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= | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 27.36 | 24.3 | 19.76 | 14.96 | 11.18 | 9.44 | 10.2 | 13.26 | 17.8 | 22.6 | 26.37 | 28.12 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 306.85 | 310.03 | 302.01 | 284.93 | 263.37 | 243.1 | 229.56 | 226.38 | 234.4 | 251.48 | 273.05 | 293.31 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | (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= | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | (71) |

# DER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 92.49 | 90.1 | 85.14 | 78.4 | 73.54 | 66.67 | 61.43 | 68.85 | 71.72 | 78.7 | 86.57 | 90.11 | (72) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 496.38 | 494.12 | 476.6 | 447.98 | 417.78 | 388.9 | 370.88 | 378.18 | 393.61 | 422.47 | 455.68 | 481.23 | (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) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast 0.9x | 0.77 | x | 2.53 | x | 11.28 | x | 0.76 | x | 0.7 | = | 10.52 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 11.28 | x | 0.76 | x | 0.7 | = | 10.52 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 11.28 | x | 0.76 | x | 0.7 | = | 10.52 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 11.28 | x | 0.76 | x | 0.7 | = | 10.52 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 22.97 | x | 0.76 | x | 0.7 | = | 21.42 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 22.97 | x | 0.76 | x | 0.7 | = | 21.42 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 22.97 | x | 0.76 | x | 0.7 | = | 21.42 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 22.97 | x | 0.76 | x | 0.7 | = | 21.42 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 41.38 | x | 0.76 | x | 0.7 | = | 38.6 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 41.38 | x | 0.76 | x | 0.7 | = | 38.6 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 41.38 | x | 0.76 | x | 0.7 | = | 38.6 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 41.38 | x | 0.76 | x | 0.7 | = | 38.6 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 67.96 | x | 0.76 | x | 0.7 | = | 63.39 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 67.96 | x | 0.76 | x | 0.7 | = | 63.39 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 67.96 | x | 0.76 | x | 0.7 | = | 63.39 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 67.96 | x | 0.76 | x | 0.7 | = | 63.39 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.35 | x | 0.76 | x | 0.7 | = | 85.2 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.35 | x | 0.76 | x | 0.7 | = | 85.2 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.35 | x | 0.76 | x | 0.7 | = | 85.2 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.35 | x | 0.76 | x | 0.7 | = | 85.2 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 97.38 | x | 0.76 | x | 0.7 | = | 90.84 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 97.38 | x | 0.76 | x | 0.7 | = | 90.84 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 97.38 | x | 0.76 | x | 0.7 | = | 90.84 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 97.38 | x | 0.76 | x | 0.7 | = | 90.84 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.1 | x | 0.76 | x | 0.7 | = | 84.97 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.1 | x | 0.76 | x | 0.7 | = | 84.97 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.1 | x | 0.76 | x | 0.7 | = | 84.97 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 91.1 | x | 0.76 | x | 0.7 | = | 84.97 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 72.63 | x | 0.76 | x | 0.7 | = | 67.74 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 72.63 | x | 0.76 | x | 0.7 | = | 67.74 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 72.63 | x | 0.76 | x | 0.7 | = | 67.74 | (75) |
| Northeast 0.9x | 0.77 | x | 2.53 | x | 72.63 | x | 0.76 | x | 0.7 | = | 67.74 | (75) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 50.42 | x | 0.76 | x | 0.7 | = | 47.03 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 50.42 | x | 0.76 | x | 0.7 | = | 47.03 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 50.42 | x | 0.76 | x | 0.7 | = | 47.03 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 50.42 | x | 0.76 | x | 0.7 | = | 47.03 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 28.07 | x | 0.76 | x | 0.7 | = | 26.18 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 28.07 | x | 0.76 | x | 0.7 | = | 26.18 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 28.07 | x | 0.76 | x | 0.7 | = | 26.18 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 28.07 | x | 0.76 | x | 0.7 | = | 26.18 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 14.2 | x | 0.76 | x | 0.7 | = | 13.24 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 14.2 | x | 0.76 | x | 0.7 | = | 13.24 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 14.2 | x | 0.76 | x | 0.7 | = | 13.24 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 14.2 | x | 0.76 | x | 0.7 | = | 13.24 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 9.21 | x | 0.76 | x | 0.7 | = | 8.59 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 9.21 | x | 0.76 | x | 0.7 | = | 8.59 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 9.21 | x | 0.76 | x | 0.7 | = | 8.59 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.53 | x | 9.21 | x | 0.76 | x | 0.7 | = | 8.59 | (75) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 36.79 | | 0.76 | x | 0.7 | = | 72.03 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 36.79 | | 0.76 | x | 0.7 | = | 110.15 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 36.79 | | 0.76 | x | 0.7 | = | 46.39 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 62.67 | | 0.76 | x | 0.7 | = | 122.69 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 62.67 | | 0.76 | x | 0.7 | = | 187.62 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 62.67 | | 0.76 | x | 0.7 | = | 79.02 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 85.75 | | 0.76 | x | 0.7 | = | 167.88 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 85.75 | | 0.76 | x | 0.7 | = | 256.71 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 85.75 | | 0.76 | x | 0.7 | = | 108.12 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 106.25 | | 0.76 | x | 0.7 | = | 208.01 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 106.25 | | 0.76 | x | 0.7 | = | 318.08 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 106.25 | | 0.76 | x | 0.7 | = | 133.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 119.01 | | 0.76 | x | 0.7 | = | 232.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 119.01 | | 0.76 | x | 0.7 | = | 356.28 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 119.01 | | 0.76 | x | 0.7 | = | 150.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 118.15 | | 0.76 | x | 0.7 | = | 231.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 118.15 | | 0.76 | x | 0.7 | = | 353.7 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 118.15 | | 0.76 | x | 0.7 | = | 148.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 113.91 | | 0.76 | x | 0.7 | = | 223 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 113.91 | | 0.76 | x | 0.7 | = | 341 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 113.91 | | 0.76 | x | 0.7 | = | 143.62 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 104.39 | | 0.76 | x | 0.7 | = | 204.36 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 104.39 | | 0.76 | x | 0.7 | = | 312.51 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 104.39 | | 0.76 | x | 0.7 | = | 131.62 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 92.85 | | 0.76 | x | 0.7 | = | 181.77 | (79) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 92.85 | | 0.76 | x | 0.7 | = | 277.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 92.85 | | 0.76 | x | 0.7 | = | 117.07 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 69.27 | | 0.76 | x | 0.7 | = | 135.6 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 69.27 | | 0.76 | x | 0.7 | = | 207.36 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 69.27 | | 0.76 | x | 0.7 | = | 87.34 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 44.07 | | 0.76 | x | 0.7 | = | 86.28 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 44.07 | | 0.76 | x | 0.7 | = | 131.93 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 44.07 | | 0.76 | x | 0.7 | = | 55.57 | (79) |
| Southwest | 0.9x | 0.77 | x | 5.31 | x | 31.49 | | 0.76 | x | 0.7 | = | 61.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 8.12 | x | 31.49 | | 0.76 | x | 0.7 | = | 94.26 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.42 | x | 31.49 | | 0.76 | x | 0.7 | = | 39.7 | (79) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 11.28 | x | 0.76 | x | 0.7 | = | 2.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 11.28 | x | 0.76 | x | 0.7 | = | 5.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 22.97 | x | 0.76 | x | 0.7 | = | 5.84 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 22.97 | x | 0.76 | x | 0.7 | = | 10.75 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 41.38 | x | 0.76 | x | 0.7 | = | 10.53 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 41.38 | x | 0.76 | x | 0.7 | = | 19.37 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 67.96 | x | 0.76 | x | 0.7 | = | 17.29 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 67.96 | x | 0.76 | x | 0.7 | = | 31.82 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 91.35 | x | 0.76 | x | 0.7 | = | 23.24 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 91.35 | x | 0.76 | x | 0.7 | = | 42.77 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 97.38 | x | 0.76 | x | 0.7 | = | 24.77 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 97.38 | x | 0.76 | x | 0.7 | = | 45.6 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 91.1 | x | 0.76 | x | 0.7 | = | 23.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 91.1 | x | 0.76 | x | 0.7 | = | 42.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 72.63 | x | 0.76 | x | 0.7 | = | 18.48 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 72.63 | x | 0.76 | x | 0.7 | = | 34.01 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 50.42 | x | 0.76 | x | 0.7 | = | 12.83 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 50.42 | x | 0.76 | x | 0.7 | = | 23.61 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 28.07 | x | 0.76 | x | 0.7 | = | 7.14 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 28.07 | x | 0.76 | x | 0.7 | = | 13.14 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 14.2 | x | 0.76 | x | 0.7 | = | 3.61 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 14.2 | x | 0.76 | x | 0.7 | = | 6.65 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.69 | x | 9.21 | x | 0.76 | x | 0.7 | = | 2.34 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.27 | x | 9.21 | x | 0.76 | x | 0.7 | = | 4.31 | (81) |
| Rooflights | 0.9x | 1 | x | 12.74 | x | 20.24 | x | 0.76 | x | 0.7 | = | 123.44 | (82) |
| Rooflights | 0.9x | 1 | x | 12.74 | x | 40.55 | x | 0.76 | x | 0.7 | = | 247.33 | (82) |
| Rooflights | 0.9x | 1 | x | 12.74 | x | 74.78 | x | 0.76 | x | 0.7 | = | 456.16 | (82) |
| Rooflights | 0.9x | 1 | x | 12.74 | x | 130.19 | x | 0.76 | x | 0.7 | = | 794.13 | (82) |
| Rooflights | 0.9x | 1 | x | 12.74 | x | 183.82 | x | 0.76 | x | 0.7 | = | 1121.29 | (82) |
| Rooflights | 0.9x | 1 | x | 12.74 | x | 200.21 | x | 0.76 | x | 0.7 | = | 1221.24 | (82) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rooflights 0.9x | 1 | x | 12.74 | x | 185.57 | x | 0.76 | x | 0.7 | = | 1131.99 | (82) |
| Rooflights 0.9x | 1 | x | 12.74 | x | 142.19 | x | 0.76 | x | 0.7 | = | 867.36 | (82) |
| Rooflights 0.9x | 1 | x | 12.74 | x | 93.09 | x | 0.76 | x | 0.7 | = | 567.83 | (82) |
| Rooflights 0.9x | 1 | x | 12.74 | x | 49.71 | x | 0.76 | x | 0.7 | = | 303.23 | (82) |
| Rooflights 0.9x | 1 | x | 12.74 | x | 25.27 | x | 0.76 | x | 0.7 | = | 154.14 | (82) |
| Rooflights 0.9x | 1 | x | 12.74 | x | 16.69 | x | 0.76 | x | 0.7 | = | 101.83 | (82) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 402.26 | 738.95 | 1173.16 | 1756.84 | 2267.43 | 2388.92 | 2245.34 | 1839.3 | 1369.2 | 858.54 | 491.14 | 338.48 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 898.65 | 1233.08 | 1649.76 | 2204.81 | 2685.2 | 2777.82 | 2616.22 | 2217.48 | 1762.8 | 1281 | 946.82 | 819.7 | (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 | 0.99 | 0.94 | 0.79 | 0.56 | 0.38 | 0.28 | 0.34 | 0.62 | 0.93 | 0.99 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.71 | 20 | 20.41 | 20.81 | 20.97 | 21 | 21 | 21 | 20.96 | 20.63 | 20.06 | 19.65 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.9 | 19.9 | 19.9 | 19.91 | 19.91 | 19.91 | 19.91 | 19.91 | 19.91 | 19.91 | 19.91 | 19.91 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.98 | 0.93 | 0.75 | 0.5 | 0.32 | 0.21 | 0.26 | 0.54 | 0.9 | 0.99 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.19 | 18.61 | 19.19 | 19.71 | 19.88 | 19.91 | 19.91 | 19.91 | 19.89 | 19.51 | 18.71 | 18.11 | (90) |

fLA = Living area ÷ (4) = 0.47 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.9 | 19.25 | 19.76 | 20.22 | 20.39 | 20.42 | 20.42 | 20.42 | 20.39 | 20.03 | 19.34 | 18.83 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.75 | 19.1 | 19.61 | 20.07 | 20.24 | 20.27 | 20.27 | 20.27 | 20.24 | 19.88 | 19.19 | 18.68 | (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 | 0.92 | 0.75 | 0.52 | 0.34 | 0.23 | 0.29 | 0.56 | 0.9 | 0.99 | 1 | (94) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 893.82 | 1207.47 | 1522.52 | 1661.87 | 1395.64 | 941.12 | 611.14 | 643.21 | 991.85 | 1148.99 | 933.64 | 816.75 | (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= | 2434.63 | 2391.13 | 2204.47 | 1871.33 | 1428.59 | 944.55 | 611.56 | 644.39 | 1024.64 | 1552.71 | 2026.75 | 2430.87 | (97) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 1146.36 | 795.42 | 507.38 | 150.81 | 24.51 | 0 | 0 | 0 | 0 | 300.37 | 787.04 | 1200.9 | |

# DER WorkSheet: New dwelling design stage

| | | |
|---|---|---|
| Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 4912.78 | (98) |
| Space heating requirement in kWh/m²/year | 35.66 | (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 | 90.4 | (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) | | | | | | | | | | | | |
| 1146.36 | 795.42 | 507.38 | 150.81 | 24.51 | 0 | 0 | 0 | 0 | 300.37 | 787.04 | 1200.9 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | (211) |
| 1268.1 | 879.89 | 561.26 | 166.82 | 27.11 | 0 | 0 | 0 | 0 | 332.26 | 870.62 | 1328.43 | |

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 5434.5 (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)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 103.88 | 98.01 | 116.98 | 120.74 | 126.54 | 114.83 | 113.39 | 123.89 | 124.11 | 120.07 | 105.08 | 100.04 |

Efficiency of water heater 80.3 (216)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 89.47 | 89.17 | 88.32 | 85.61 | 81.78 | 80.3 | 80.3 | 80.3 | 80.3 | 87.27 | 89.08 | 89.53 |

(217)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 116.11 | 109.92 | 132.46 | 141.03 | 154.73 | 143.01 | 141.2 | 154.29 | 154.55 | 137.59 | 117.96 | 111.74 |

Total = Sum(219a)$_{1...12}$ = 1614.58 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 5434.5 |
| Water heating fuel used | | 1614.58 |
| 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 | | 483.11 (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 | = | 1173.85 (261) |

# DER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 348.75 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1522.6 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 250.74 | (268) |
| Energy saving/generation technologies | | | | | |
| Total CO2, kg/year | sum of (265)…(271) = | | | 1812.26 | (272) |
| **Dwelling CO2 Emission Rate** | (272) ÷ (4) = | | | 13.16 | (273) |
| EI rating (section 14) | | | | 87 | (274) |

# TER WorkSheet: New dwelling design stage

build energy — compliance testing consulting

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Peter Mitchell | **Stroma Number:** | STRO007945 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.3.15 |

## Property Address: Unit 1 (GF&FF END) CLEAN

**Address :** New Dwelling at:, Gordon House, 6 Lissenden Gardens, LONDON, NW5 1LX

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 73.62 | (1a) x | 2.4 | (2a) = | 176.69 | (3a) |
| First floor | 64.14 | (1b) x | 3.32 | (2b) = | 212.94 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 137.76 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 389.63 | (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 | | | 5 (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | 0.35 (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | | 3 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 0.78 (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | | 0.27 (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 |

# TER WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.35 | 0.34 | 0.33 | 0.3 | 0.29 | 0.26 | 0.26 | 0.25 | 0.27 | 0.29 | 0.31 | 0.32 |

*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= | 0.56 | 0.56 | 0.56 | 0.55 | 0.54 | 0.53 | 0.53 | 0.53 | 0.54 | 0.54 | 0.55 | 0.55 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.56 | 0.56 | 0.56 | 0.55 | 0.54 | 0.53 | 0.53 | 0.53 | 0.54 | 0.54 | 0.55 | 0.55 |

(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 | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.39 | x1/[1/( 1.4 )+ 0.04] = | 5.82 | | | (27) |
| Windows Type 2 | | | 6.71 | x1/[1/( 1.4 )+ 0.04] = | 8.9 | | | (27) |
| Windows Type 3 | | | 2.09 | x1/[1/( 1.4 )+ 0.04] = | 2.77 | | | (27) |
| Windows Type 4 | | | 2.09 | x1/[1/( 1.4 )+ 0.04] = | 2.77 | | | (27) |
| Windows Type 5 | | | 2.09 | x1/[1/( 1.4 )+ 0.04] = | 2.77 | | | (27) |
| Windows Type 6 | | | 2.09 | x1/[1/( 1.4 )+ 0.04] = | 2.77 | | | (27) |
| Windows Type 7 | | | 0.57 | x1/[1/( 1.4 )+ 0.04] = | 0.76 | | | (27) |
| Windows Type 8 | | | 1.05 | x1/[1/( 1.4 )+ 0.04] = | 1.39 | | | (27) |
| Windows Type 9 | | | 2.83 | x1/[1/( 1.4 )+ 0.04] = | 3.75 | | | (27) |
| Rooflights | | | 10.52953 | x1/[1/(1.7) + 0.04] = | 17.90021 | | | (27b) |
| Walls | 147.2 | 23.91 | 123.29 | x 0.18 = | 22.19 | | | (29) |
| Roof Type1 | 9.48 | 0 | 9.48 | x 0.13 = | 1.23 | | | (30) |
| Roof Type2 | 71.67 | 10.53 | 61.14 | x 0.13 = | 7.95 | | | (30) |
| Total area of elements, m² | | | 228.35 | | | | | (31) |
| Party wall | | | 37.15 | x 0 = | 0 | | | (32) |
| Party wall | | | 11.57 | x 0 = | 0 | | | (32) |

** 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) = 79.83 (33)

# TER WorkSheet: New dwelling design stage

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 6.8 (36)

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

Total fabric heat loss (33) + (36) = 86.64 (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= | 72.1 | 71.79 | 71.5 | 70.1 | 69.84 | 68.62 | 68.62 | 68.4 | 69.09 | 69.84 | 70.37 | 70.92 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 158.73 | 158.43 | 158.13 | 156.74 | 156.47 | 155.26 | 155.26 | 155.03 | 155.73 | 156.47 | 157 | 157.56 | |

Average = Sum(39)$_{1...12}$ /12= 156.73 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.15 | 1.15 | 1.15 | 1.14 | 1.14 | 1.13 | 1.13 | 1.13 | 1.13 | 1.14 | 1.14 | 1.14 | |

Average = Sum(40)$_{1...12}$ /12= 1.14 (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 2.91 (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) + 36 103.38 (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= | 113.71 | 109.58 | 105.44 | 101.31 | 97.17 | 93.04 | 93.04 | 97.17 | 101.31 | 105.44 | 109.58 | 113.71 | |

Total = Sum(44)$_{1...12}$ = 1240.52 (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= | 168.63 | 147.49 | 152.2 | 132.69 | 127.32 | 109.86 | 101.81 | 116.82 | 118.22 | 137.77 | 150.39 | 163.31 | |

Total = Sum(45)$_{1...12}$ = 1626.52 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25.3 | 22.12 | 22.83 | 19.9 | 19.1 | 16.48 | 15.27 | 17.52 | 17.73 | 20.67 | 22.56 | 24.5 | (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:

# TER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| 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 | 46.03 | 50.96 | 49.32 | 49.52 | 45.88 | 47.41 | 49.52 | 49.32 | 50.96 | 49.32 | 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= | 219.59 | 193.52 | 203.15 | 182 | 176.84 | 155.75 | 149.22 | 166.34 | 167.53 | 188.73 | 199.71 | 214.27 | (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) |
| FHRS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) (G2) |
| WWHRS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) (G10) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 219.59 | 193.52 | 203.15 | 182 | 176.84 | 155.75 | 149.22 | 166.34 | 167.53 | 188.73 | 199.71 | 214.27 | |

| | | |
|---|---|---|
| Output from water heater (annual)$_{1...12}$ | 2216.65 | (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= | 68.81 | 60.55 | 63.34 | 56.45 | 54.71 | 48 | 45.7 | 51.22 | 51.64 | 58.55 | 62.33 | 67.04 | (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= | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | 145.63 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 27.36 | 24.3 | 19.76 | 14.96 | 11.18 | 9.44 | 10.2 | 13.26 | 17.8 | 22.6 | 26.37 | 28.12 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 306.85 | 310.03 | 302.01 | 284.93 | 263.37 | 243.1 | 229.56 | 226.38 | 234.4 | 251.48 | 273.05 | 293.31 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | 37.56 | (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= | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | -116.51 | (71) |

# TER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 92.49 | 90.1 | 85.14 | 78.4 | 73.54 | 66.67 | 61.43 | 68.85 | 71.72 | 78.7 | 86.57 | 90.11 | (72) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 496.38 | 494.12 | 476.6 | 447.98 | 417.78 | 388.9 | 370.88 | 378.18 | 393.61 | 422.47 | 455.68 | 481.23 | (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) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast 0.9x | 0.77 | x | 2.09 | x | 11.28 | x | 0.63 | x | 0.7 | = | 7.21 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 11.28 | x | 0.63 | x | 0.7 | = | 7.21 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 11.28 | x | 0.63 | x | 0.7 | = | 7.21 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 11.28 | x | 0.63 | x | 0.7 | = | 7.21 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 22.97 | x | 0.63 | x | 0.7 | = | 14.67 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 22.97 | x | 0.63 | x | 0.7 | = | 14.67 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 22.97 | x | 0.63 | x | 0.7 | = | 14.67 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 22.97 | x | 0.63 | x | 0.7 | = | 14.67 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 41.38 | x | 0.63 | x | 0.7 | = | 26.43 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 41.38 | x | 0.63 | x | 0.7 | = | 26.43 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 41.38 | x | 0.63 | x | 0.7 | = | 26.43 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 41.38 | x | 0.63 | x | 0.7 | = | 26.43 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 67.96 | x | 0.63 | x | 0.7 | = | 43.41 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 67.96 | x | 0.63 | x | 0.7 | = | 43.41 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 67.96 | x | 0.63 | x | 0.7 | = | 43.41 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 67.96 | x | 0.63 | x | 0.7 | = | 43.41 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 91.35 | x | 0.63 | x | 0.7 | = | 58.35 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 91.35 | x | 0.63 | x | 0.7 | = | 58.35 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 91.35 | x | 0.63 | x | 0.7 | = | 58.35 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 91.35 | x | 0.63 | x | 0.7 | = | 58.35 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 97.38 | x | 0.63 | x | 0.7 | = | 62.2 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 97.38 | x | 0.63 | x | 0.7 | = | 62.2 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 97.38 | x | 0.63 | x | 0.7 | = | 62.2 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 97.38 | x | 0.63 | x | 0.7 | = | 62.2 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 91.1 | x | 0.63 | x | 0.7 | = | 58.19 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 91.1 | x | 0.63 | x | 0.7 | = | 58.19 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 91.1 | x | 0.63 | x | 0.7 | = | 58.19 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 91.1 | x | 0.63 | x | 0.7 | = | 58.19 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 72.63 | x | 0.63 | x | 0.7 | = | 46.39 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 72.63 | x | 0.63 | x | 0.7 | = | 46.39 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 72.63 | x | 0.63 | x | 0.7 | = | 46.39 | (75) |
| Northeast 0.9x | 0.77 | x | 2.09 | x | 72.63 | x | 0.63 | x | 0.7 | = | 46.39 | (75) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 50.42 | x | 0.63 | x | 0.7 | = | 32.21 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 50.42 | x | 0.63 | x | 0.7 | = | 32.21 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 50.42 | x | 0.63 | x | 0.7 | = | 32.21 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 50.42 | x | 0.63 | x | 0.7 | = | 32.21 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 28.07 | x | 0.63 | x | 0.7 | = | 17.93 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 28.07 | x | 0.63 | x | 0.7 | = | 17.93 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 28.07 | x | 0.63 | x | 0.7 | = | 17.93 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 28.07 | x | 0.63 | x | 0.7 | = | 17.93 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 14.2 | x | 0.63 | x | 0.7 | = | 9.07 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 14.2 | x | 0.63 | x | 0.7 | = | 9.07 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 14.2 | x | 0.63 | x | 0.7 | = | 9.07 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 14.2 | x | 0.63 | x | 0.7 | = | 9.07 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 9.21 | x | 0.63 | x | 0.7 | = | 5.89 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 9.21 | x | 0.63 | x | 0.7 | = | 5.89 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 9.21 | x | 0.63 | x | 0.7 | = | 5.89 | (75) |
| Northeast | 0.9x | 0.77 | x | 2.09 | x | 9.21 | x | 0.63 | x | 0.7 | = | 5.89 | (75) |
| Southwest | 0.9x | 0.77 | x | 4.39 | x | 36.79 | | 0.63 | x | 0.7 | = | 49.36 | (79) |
| Southwest | 0.9x | 0.77 | x | 6.71 | x | 36.79 | | 0.63 | x | 0.7 | = | 75.45 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.83 | x | 36.79 | | 0.63 | x | 0.7 | = | 31.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 4.39 | x | 62.67 | | 0.63 | x | 0.7 | = | 84.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 6.71 | x | 62.67 | | 0.63 | x | 0.7 | = | 128.52 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.83 | x | 62.67 | | 0.63 | x | 0.7 | = | 54.21 | (79) |
| Southwest | 0.9x | 0.77 | x | 4.39 | x | 85.75 | | 0.63 | x | 0.7 | = | 115.05 | (79) |
| Southwest | 0.9x | 0.77 | x | 6.71 | x | 85.75 | | 0.63 | x | 0.7 | = | 175.85 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.83 | x | 85.75 | | 0.63 | x | 0.7 | = | 74.17 | (79) |
| Southwest | 0.9x | 0.77 | x | 4.39 | x | 106.25 | | 0.63 | x | 0.7 | = | 142.55 | (79) |
| Southwest | 0.9x | 0.77 | x | 6.71 | x | 106.25 | | 0.63 | x | 0.7 | = | 217.89 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.83 | x | 106.25 | | 0.63 | x | 0.7 | = | 91.9 | (79) |
| Southwest | 0.9x | 0.77 | x | 4.39 | x | 119.01 | | 0.63 | x | 0.7 | = | 159.67 | (79) |
| Southwest | 0.9x | 0.77 | x | 6.71 | x | 119.01 | | 0.63 | x | 0.7 | = | 244.05 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.83 | x | 119.01 | | 0.63 | x | 0.7 | = | 102.93 | (79) |
| Southwest | 0.9x | 0.77 | x | 4.39 | x | 118.15 | | 0.63 | x | 0.7 | = | 158.51 | (79) |
| Southwest | 0.9x | 0.77 | x | 6.71 | x | 118.15 | | 0.63 | x | 0.7 | = | 242.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.83 | x | 118.15 | | 0.63 | x | 0.7 | = | 102.19 | (79) |
| Southwest | 0.9x | 0.77 | x | 4.39 | x | 113.91 | | 0.63 | x | 0.7 | = | 152.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 6.71 | x | 113.91 | | 0.63 | x | 0.7 | = | 233.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.83 | x | 113.91 | | 0.63 | x | 0.7 | = | 98.52 | (79) |
| Southwest | 0.9x | 0.77 | x | 4.39 | x | 104.39 | | 0.63 | x | 0.7 | = | 140.05 | (79) |
| Southwest | 0.9x | 0.77 | x | 6.71 | x | 104.39 | | 0.63 | x | 0.7 | = | 214.07 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.83 | x | 104.39 | | 0.63 | x | 0.7 | = | 90.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 4.39 | x | 92.85 | | 0.63 | x | 0.7 | = | 124.57 | (79) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 6.71 | x | 92.85 | | 0.63 | x | 0.7 | = | 190.41 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.83 | x | 92.85 | | 0.63 | x | 0.7 | = | 80.31 | (79) |
| Southwest | 0.9x | 0.77 | x | 4.39 | x | 69.27 | | 0.63 | x | 0.7 | = | 92.93 | (79) |
| Southwest | 0.9x | 0.77 | x | 6.71 | x | 69.27 | | 0.63 | x | 0.7 | = | 142.04 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.83 | x | 69.27 | | 0.63 | x | 0.7 | = | 59.91 | (79) |
| Southwest | 0.9x | 0.77 | x | 4.39 | x | 44.07 | | 0.63 | x | 0.7 | = | 59.13 | (79) |
| Southwest | 0.9x | 0.77 | x | 6.71 | x | 44.07 | | 0.63 | x | 0.7 | = | 90.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.83 | x | 44.07 | | 0.63 | x | 0.7 | = | 38.12 | (79) |
| Southwest | 0.9x | 0.77 | x | 4.39 | x | 31.49 | | 0.63 | x | 0.7 | = | 42.25 | (79) |
| Southwest | 0.9x | 0.77 | x | 6.71 | x | 31.49 | | 0.63 | x | 0.7 | = | 64.57 | (79) |
| Southwest | 0.9x | 0.77 | x | 2.83 | x | 31.49 | | 0.63 | x | 0.7 | = | 27.23 | (79) |
| Northwest | 0.9x | 0.77 | x | 0.57 | x | 11.28 | x | 0.63 | x | 0.7 | = | 1.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.05 | x | 11.28 | x | 0.63 | x | 0.7 | = | 3.62 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.57 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.05 | x | 22.97 | x | 0.63 | x | 0.7 | = | 7.37 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.57 | x | 41.38 | x | 0.63 | x | 0.7 | = | 7.21 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.05 | x | 41.38 | x | 0.63 | x | 0.7 | = | 13.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.57 | x | 67.96 | x | 0.63 | x | 0.7 | = | 11.84 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.05 | x | 67.96 | x | 0.63 | x | 0.7 | = | 21.81 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.57 | x | 91.35 | x | 0.63 | x | 0.7 | = | 15.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.05 | x | 91.35 | x | 0.63 | x | 0.7 | = | 29.31 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.57 | x | 97.38 | x | 0.63 | x | 0.7 | = | 16.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.05 | x | 97.38 | x | 0.63 | x | 0.7 | = | 31.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.57 | x | 91.1 | x | 0.63 | x | 0.7 | = | 15.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.05 | x | 91.1 | x | 0.63 | x | 0.7 | = | 29.23 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.57 | x | 72.63 | x | 0.63 | x | 0.7 | = | 12.65 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.05 | x | 72.63 | x | 0.63 | x | 0.7 | = | 23.31 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.57 | x | 50.42 | x | 0.63 | x | 0.7 | = | 8.78 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.05 | x | 50.42 | x | 0.63 | x | 0.7 | = | 16.18 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.57 | x | 28.07 | x | 0.63 | x | 0.7 | = | 4.89 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.05 | x | 28.07 | x | 0.63 | x | 0.7 | = | 9.01 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.57 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.47 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.05 | x | 14.2 | x | 0.63 | x | 0.7 | = | 4.56 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.57 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.61 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.05 | x | 9.21 | x | 0.63 | x | 0.7 | = | 2.96 | (81) |
| Rooflights | 0.9x | 1 | x | 10.53 | x | 20.24 | x | 0.63 | x | 0.7 | = | 84.57 | (82) |
| Rooflights | 0.9x | 1 | x | 10.53 | x | 40.55 | x | 0.63 | x | 0.7 | = | 169.45 | (82) |
| Rooflights | 0.9x | 1 | x | 10.53 | x | 74.78 | x | 0.63 | x | 0.7 | = | 312.52 | (82) |
| Rooflights | 0.9x | 1 | x | 10.53 | x | 130.19 | x | 0.63 | x | 0.7 | = | 544.08 | (82) |
| Rooflights | 0.9x | 1 | x | 10.53 | x | 183.82 | x | 0.63 | x | 0.7 | = | 768.22 | (82) |
| Rooflights | 0.9x | 1 | x | 10.53 | x | 200.21 | x | 0.63 | x | 0.7 | = | 836.7 | (82) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rooflights 0.9x | 1 | x | 10.53 | x | 185.57 | x | 0.63 | x | 0.7 | = | 775.55 | (82) |
| Rooflights 0.9x | 1 | x | 10.53 | x | 142.19 | x | 0.63 | x | 0.7 | = | 594.24 | (82) |
| Rooflights 0.9x | 1 | x | 10.53 | x | 93.09 | x | 0.63 | x | 0.7 | = | 389.03 | (82) |
| Rooflights 0.9x | 1 | x | 10.53 | x | 49.71 | x | 0.63 | x | 0.7 | = | 207.75 | (82) |
| Rooflights 0.9x | 1 | x | 10.53 | x | 25.27 | x | 0.63 | x | 0.7 | = | 105.6 | (82) |
| Rooflights 0.9x | 1 | x | 10.53 | x | 16.69 | x | 0.63 | x | 0.7 | = | 69.77 | (82) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 275.63 | 506.31 | 803.79 | 1203.68 | 1553.48 | 1636.71 | 1538.34 | 1260.17 | 938.1 | 588.24 | 336.52 | 231.92 | (83) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 772.01 | 1000.43 | 1280.4 | 1651.65 | 1971.25 | 2025.61 | 1909.22 | 1638.34 | 1331.71 | 1010.71 | 792.2 | 713.15 | (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= | 1 | 0.99 | 0.98 | 0.89 | 0.69 | 0.48 | 0.36 | 0.43 | 0.74 | 0.96 | 1 | 1 | (86) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.72 | 19.94 | 20.29 | 20.71 | 20.93 | 20.99 | 21 | 21 | 20.93 | 20.55 | 20.05 | 19.68 | (87) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.96 | 19.96 | 19.96 | 19.97 | 19.97 | 19.98 | 19.98 | 19.98 | 19.98 | 19.97 | 19.97 | 19.97 | (88) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.97 | 0.86 | 0.63 | 0.41 | 0.27 | 0.34 | 0.65 | 0.95 | 0.99 | 1 | (89) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.25 | 18.57 | 19.07 | 19.65 | 19.91 | 19.97 | 19.98 | 19.98 | 19.93 | 19.46 | 18.74 | 18.19 | (90) |

fLA = Living area ÷ (4) = 0.47 (91)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.93 | 19.21 | 19.64 | 20.14 | 20.39 | 20.45 | 20.45 | 20.45 | 20.4 | 19.97 | 19.35 | 18.89 | (92) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.93 | 19.21 | 19.64 | 20.14 | 20.39 | 20.45 | 20.45 | 20.45 | 20.4 | 19.97 | 19.35 | 18.89 | (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 | 0.99 | 0.96 | 0.86 | 0.65 | 0.44 | 0.31 | 0.38 | 0.69 | 0.95 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 769.96 | 991.2 | 1234.97 | 1421.98 | 1288.13 | 899.45 | 597.16 | 625.37 | 916.32 | 957.67 | 786.95 | 711.85 | (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= | 2322.59 | 2266.67 | 2077.67 | 1761.69 | 1359.63 | 907.82 | 598.25 | 628.26 | 980.65 | 1466.25 | 1922.8 | 2313.83 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 1155.16 | 857.12 | 626.97 | 244.59 | 53.2 | 0 | 0 | 0 | 0 | 378.39 | 817.81 | 1191.87 | |

# TER WorkSheet: New dwelling design stage

| | | |
|---|---|---|
| Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 5325.1 | (98) |
| Space heating requirement in kWh/m²/year | 38.65 | (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 | 93.4 | (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) | | | | | | | | | | | | |
| 1155.16 | 857.12 | 626.97 | 244.59 | 53.2 | 0 | 0 | 0 | 0 | 378.39 | 817.81 | 1191.87 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | (211) |
| 1236.78 | 917.68 | 671.28 | 261.87 | 56.96 | 0 | 0 | 0 | 0 | 405.13 | 875.6 | 1276.1 | |

| | | |
|---|---|---|
| Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | 5701.4 | (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)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 219.59 | 193.52 | 203.15 | 182 | 176.84 | 155.75 | 149.22 | 166.34 | 167.53 | 188.73 | 199.71 | 214.27 |

| | | |
|---|---|---|
| Efficiency of water heater | 80.3 | (216) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 88.62 | 88.35 | 87.7 | 85.8 | 82.43 | 80.3 | 80.3 | 80.3 | 80.3 | 86.77 | 88.22 | 88.7 |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 247.79 | 219.03 | 231.65 | 212.13 | 214.53 | 193.96 | 185.83 | 207.15 | 208.64 | 217.51 | 226.37 | 241.57 |

| | | |
|---|---|---|
| Total = Sum(219a)$_{1...12}$ = | 2606.15 | (219) |

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 5701.4 | |
| Water heating fuel used | | 2606.15 | |
| 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 | | 483.11 | (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 | = | 1231.5 | (261) |

# TER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 562.93 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1794.43 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 250.74 | (268) |
| Total CO2, kg/year | sum of (265)…(271) = | | | 2084.09 | (272) |

**TER =** 15.13 (273)