# Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.51
*Printed on 09 June 2022 at 20:51:36*

## Project Information:

**Assessed By:** Michael Langley (STRO036755) **Building Type:** Flat

## Dwelling Details:

**NEW DWELLING DESIGN STAGE** Total Floor Area: 60.71m²

**Site Reference :** 11-12 Market Place **Plot Reference:** Flat 16 (Be Lean)

**Address :** Flat 16, 11-12 Market Place, READING, RG1 2EG

## Client Details:

**Name:**

**Address :**

**This report covers items included within the SAP calculations.**
**It is not a complete report of regulations compliance.**

## 1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

| | | |
|---|---|---|
| Target Carbon Dioxide Emission Rate (TER) | 24.64 kg/m² | |
| Dwelling Carbon Dioxide Emission Rate (DER) | 20.47 kg/m² | **OK** |

## 1b TFEE and DFEE

| | | |
|---|---|---|
| Target Fabric Energy Efficiency (TFEE) | 79.4 kWh/m² | |
| Dwelling Fabric Energy Efficiency (DFEE) | 59.6 kWh/m² | |
| | | **OK** |

## 2 Fabric U-values

| Element | Average | Highest | |
|---|---|---|---|
| External wall | 0.14 (max. 0.30) | 0.14 (max. 0.70) | **OK** |
| Party wall | 0.00 (max. 0.20) | - | **OK** |
| Floor | (no floor) | | |
| Roof | 0.13 (max. 0.20) | 0.13 (max. 0.35) | **OK** |
| Openings | 1.11 (max. 2.00) | 1.20 (max. 3.30) | **OK** |

## 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

## 3 Air permeability

| | | |
|---|---|---|
| Air permeability at 50 pascals | 3.00 (design value) | |
| Maximum | 10.0 | **OK** |

## 4 Heating efficiency

| | | |
|---|---|---|
| Main Heating system: | Boiler systems with radiators or underfloor heating - mains gas<br>Data from manufacturer<br>Efficiency 89.5 % SEDBUK2009<br>Minimum 88.0 % | **OK** |
| Secondary heating system: | None | |

## 5 Cylinder insulation

| | | |
|---|---|---|
| Hot water Storage: | Measured cylinder loss: 1.61 kWh/day<br>Permitted by DBSCG: 2.56 kWh/day | **OK** |

# Regulations Compliance Report

| | | |
|---|---|---|
| Primary pipework insulated: | Yes | OK |

## 6 Controls

| | | |
|---|---|---|
| Space heating controls | Time and temperature zone control by device in database | OK |
| Hot water controls: | Cylinderstat | OK |
| | Independent timer for DHW | OK |
| Boiler interlock: | Yes | OK |

## 7 Low energy lights

| | | |
|---|---|---|
| Percentage of fixed lights with low-energy fittings | 100.0% | |
| Minimum | 75.0% | OK |

## 8 Mechanical ventilation

| | | |
|---|---|---|
| Continuous supply and extract system | | |
| Specific fan power: | 0.5 | |
| Maximum | 1.5 | OK |
| MVHR efficiency: | 91% | |
| Minimum | 70% | OK |

## 9 Summertime temperature

| | | |
|---|---|---|
| Overheating risk (Thames valley): | Medium | OK |

Based on:

| | |
|---|---|
| Overshading: | Average or unknown |
| Windows facing: North West | 2.04m² |
| Windows facing: North West | 2.47m² |
| Windows facing: North West | 2.37m² |
| Windows facing: North West | 2.04m² |
| Windows facing: North West | 3.81m² |
| Roof windows facing: Horizontal | 1.1m² |
| Roof windows facing: Horizontal | 0.76m² |
| Ventilation rate: | 4.00 |
| Blinds/curtains: | None |

## 10 Key features

| | |
|---|---|
| Air permeablility | 3.0 m³/m²h |
| Windows U-value | 1 W/m²K |
| Party Walls U-value | 0 W/m²K |

# EPC Costs WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Michael Langley | **Stroma Number:** | STRO036755 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.5.51 |

## Property Address: Flat 16 (Be Lean)

**Address :** Flat 16, 11-12 Market Place, READING, RG1 2EG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 60.71 | (1a) x | 3.5 | (2a) = | 212.48 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 60.71 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 212.48 | (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 | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

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

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 1 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.92 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.14 | (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= | 4.3 | 4.1 | 4.1 | 3.8 | 3.9 | 3.4 | 3.4 | 3.3 | 3.4 | 3.8 | 3.7 | 4 |

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.08 | 1.02 | 1.02 | 0.95 | 0.98 | 0.85 | 0.85 | 0.82 | 0.85 | 0.95 | 0.92 | 1 |

# EPC Costs WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.15 | 0.14 | 0.14 | 0.13 | 0.14 | 0.12 | 0.12 | 0.11 | 0.12 | 0.13 | 0.13 | 0.14 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.26 | 0.26 | 0.26 | 0.25 | 0.25 | 0.23 | 0.23 | 0.23 | 0.23 | 0.25 | 0.24 | 0.25 | (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 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.26 | 0.26 | 0.26 | 0.25 | 0.25 | 0.23 | 0.23 | 0.23 | 0.23 | 0.25 | 0.24 | 0.25 | (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 | | | 2.04 | x 1/[1/( 1 )+ 0.04] | | = | 1.96 | | | (27) |
| Windows Type 2 | | | 2.47 | x 1/[1/( 1 )+ 0.04] | | = | 2.38 | | | (27) |
| Windows Type 3 | | | 2.37 | x 1/[1/( 1 )+ 0.04] | | = | 2.28 | | | (27) |
| Windows Type 4 | | | 2.04 | x1/[1/( 1.2 )+ 0.04] | | = | 2.34 | | | (27) |
| Windows Type 5 | | | 3.81 | x1/[1/( 1.2 )+ 0.04] | | = | 4.36 | | | (27) |
| Rooflights Type 1 | | | 1.1 | x1/[1/(1.2) + 0.04] | | = | 1.32 | | | (27b) |
| Rooflights Type 2 | | | 0.765 | x1/[1/(1.2) + 0.04] | | = | 0.918 | | | (27b) |
| Walls | 76.51 | 12.73 | 63.78 | x | 0.14 | = | 8.93 | | | (29) |
| Roof | 60.71 | 1.87 | 58.84 | x | 0.13 | = | 7.65 | | | (30) |
| Total area of elements, m² | | | 137.22 | | | | | | | (31) |
| Party wall | | | 55.51 | x | 0 | = | 0 | | | (32) |
| Party floor | | | 60.71 | | | | | | | (32a) |
| Internal wall ** | | | 168.16 | | | | | | | (32c) |

** 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) = 32.03 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 6155.66 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 22.29 (36)

# EPC Costs WorkSheet: New dwelling design stage

*if details of thermal bridging are not known (36) = 0.05 x (31)*

Total fabric heat loss (33) + (36) = 54.32 (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= | 18.4 | 17.91 | 17.91 | 17.18 | 17.43 | 16.21 | 16.21 | 15.97 | 16.21 | 17.18 | 16.94 | 17.67 | (38) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 72.72 | 72.23 | 72.23 | 71.51 | 71.75 | 70.53 | 70.53 | 70.29 | 70.53 | 71.51 | 71.26 | 71.99 |

Average = Sum(39)$_{1...12}$ /12= 71.42 (39)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.2 | 1.19 | 1.19 | 1.18 | 1.18 | 1.16 | 1.16 | 1.16 | 1.16 | 1.18 | 1.17 | 1.19 |

Average = Sum(40)$_{1...12}$ /12= 1.18 (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 (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 81.74 (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= | 89.91 | 86.64 | 83.37 | 80.1 | 76.83 | 73.56 | 73.56 | 76.83 | 80.1 | 83.37 | 86.64 | 89.91 |

Total = Sum(44)$_{1...12}$ = 980.87 (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= | 133.34 | 116.62 | 120.34 | 104.91 | 100.67 | 86.87 | 80.5 | 92.37 | 93.47 | 108.94 | 118.91 | 129.13 |

Total = Sum(45)$_{1...12}$ = 1286.07 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 20 | 17.49 | 18.05 | 15.74 | 15.1 | 13.03 | 12.07 | 13.86 | 14.02 | 16.34 | 17.84 | 19.37 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (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): 1.61 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.87 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.87 (55)

# EPC Costs WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 26.95 | 24.34 | 26.95 | 26.08 | 26.95 | 26.08 | 26.95 | 26.95 | 26.08 | 26.95 | 26.08 | 26.95 | (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= | 26.95 | 24.34 | 26.95 | 26.08 | 26.95 | 26.08 | 26.95 | 26.95 | 26.08 | 26.95 | 26.08 | 26.95 | (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= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (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= | 183.55 | 161.97 | 170.55 | 153.51 | 150.88 | 135.46 | 130.71 | 142.59 | 142.07 | 159.15 | 167.51 | 179.34 | (62) |

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

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

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

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 183.55 | 161.97 | 170.55 | 153.51 | 150.88 | 135.46 | 130.71 | 142.59 | 142.07 | 159.15 | 167.51 | 179.34 |

Output from water heater (annual)$_{1...12}$ | 1877.3 | (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= | 84.51 | 75.06 | 80.18 | 73.76 | 73.64 | 67.76 | 66.94 | 70.88 | 69.96 | 76.39 | 78.41 | 83.11 | (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= | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 38.94 | 34.59 | 28.13 | 21.3 | 15.92 | 13.44 | 14.52 | 18.88 | 25.34 | 32.17 | 37.55 | 40.03 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 260.8 | 263.5 | 256.68 | 242.17 | 223.84 | 206.61 | 195.11 | 192.4 | 199.22 | 213.74 | 232.07 | 249.29 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | (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= | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 113.58 | 111.7 | 107.77 | 102.44 | 98.98 | 94.11 | 89.97 | 95.27 | 97.16 | 102.68 | 108.91 | 111.7 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 505.37 | 501.83 | 484.63 | 457.95 | 430.78 | 406.21 | 391.64 | 398.6 | 413.76 | 440.63 | 470.56 | 493.06 | (73) |

## 6. Solar gains:

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

# EPC Costs WorkSheet: New dwelling design stage

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 2.04 | x | 13.78 | x | 0.63 | x | 0.8 | = | 9.82 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 13.78 | x | 0.63 | x | 0.8 | = | 11.89 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 13.78 | x | 0.63 | x | 0.8 | = | 11.41 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 13.78 | x | 0.63 | x | 0.8 | = | 9.82 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 13.78 | x | 0.63 | x | 0.8 | = | 18.34 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 24.65 | x | 0.63 | x | 0.8 | = | 17.56 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 24.65 | x | 0.63 | x | 0.8 | = | 21.26 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 24.65 | x | 0.63 | x | 0.8 | = | 20.4 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 24.65 | x | 0.63 | x | 0.8 | = | 17.56 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 24.65 | x | 0.63 | x | 0.8 | = | 32.8 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 44.26 | x | 0.63 | x | 0.8 | = | 31.53 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 44.26 | x | 0.63 | x | 0.8 | = | 38.18 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 44.26 | x | 0.63 | x | 0.8 | = | 36.63 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 44.26 | x | 0.63 | x | 0.8 | = | 31.53 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 44.26 | x | 0.63 | x | 0.8 | = | 58.89 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 73.71 | x | 0.63 | x | 0.8 | = | 52.52 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 73.71 | x | 0.63 | x | 0.8 | = | 63.59 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 73.71 | x | 0.63 | x | 0.8 | = | 61.02 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 73.71 | x | 0.63 | x | 0.8 | = | 52.52 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 73.71 | x | 0.63 | x | 0.8 | = | 98.09 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 96.2 | x | 0.63 | x | 0.8 | = | 68.54 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 96.2 | x | 0.63 | x | 0.8 | = | 82.99 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 96.2 | x | 0.63 | x | 0.8 | = | 79.63 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 96.2 | x | 0.63 | x | 0.8 | = | 68.54 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 96.2 | x | 0.63 | x | 0.8 | = | 128.01 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 108.24 | x | 0.63 | x | 0.8 | = | 77.12 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 108.24 | x | 0.63 | x | 0.8 | = | 93.38 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 108.24 | x | 0.63 | x | 0.8 | = | 89.6 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 108.24 | x | 0.63 | x | 0.8 | = | 77.12 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 108.24 | x | 0.63 | x | 0.8 | = | 144.04 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 100.36 | x | 0.63 | x | 0.8 | = | 71.51 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 100.36 | x | 0.63 | x | 0.8 | = | 86.58 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 100.36 | x | 0.63 | x | 0.8 | = | 83.07 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 100.36 | x | 0.63 | x | 0.8 | = | 71.51 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 100.36 | x | 0.63 | x | 0.8 | = | 133.55 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 82.32 | x | 0.63 | x | 0.8 | = | 58.65 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 82.32 | x | 0.63 | x | 0.8 | = | 71.01 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 82.32 | x | 0.63 | x | 0.8 | = | 68.14 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 82.32 | x | 0.63 | x | 0.8 | = | 58.65 | (81) |

# EPC Costs WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 3.81 | x | 82.32 | x | 0.63 | x | 0.8 | = | 109.54 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 57.5 | x | 0.63 | x | 0.8 | = | 40.97 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 57.5 | x | 0.63 | x | 0.8 | = | 49.6 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 57.5 | x | 0.63 | x | 0.8 | = | 47.59 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 57.5 | x | 0.63 | x | 0.8 | = | 40.97 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 57.5 | x | 0.63 | x | 0.8 | = | 76.51 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 32.39 | x | 0.63 | x | 0.8 | = | 23.08 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 32.39 | x | 0.63 | x | 0.8 | = | 27.95 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 32.39 | x | 0.63 | x | 0.8 | = | 26.81 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 32.39 | x | 0.63 | x | 0.8 | = | 23.08 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 32.39 | x | 0.63 | x | 0.8 | = | 43.11 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 17.11 | x | 0.63 | x | 0.8 | = | 12.19 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 17.11 | x | 0.63 | x | 0.8 | = | 14.76 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 17.11 | x | 0.63 | x | 0.8 | = | 14.16 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 17.11 | x | 0.63 | x | 0.8 | = | 12.19 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 17.11 | x | 0.63 | x | 0.8 | = | 22.77 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 11.3 | x | 0.63 | x | 0.8 | = | 8.05 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 11.3 | x | 0.63 | x | 0.8 | = | 9.75 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 11.3 | x | 0.63 | x | 0.8 | = | 9.35 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 11.3 | x | 0.63 | x | 0.8 | = | 8.05 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 11.3 | x | 0.63 | x | 0.8 | = | 15.03 | (81) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 32 | x | 0.63 | x | 0.8 | = | 15.97 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 32 | x | 0.63 | x | 0.8 | = | 11.1 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 58 | x | 0.63 | x | 0.8 | = | 28.94 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 58 | x | 0.63 | x | 0.8 | = | 20.13 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 102 | x | 0.63 | x | 0.8 | = | 50.89 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 102 | x | 0.63 | x | 0.8 | = | 35.39 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 161 | x | 0.63 | x | 0.8 | = | 80.33 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 161 | x | 0.63 | x | 0.8 | = | 55.87 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 200 | x | 0.63 | x | 0.8 | = | 99.79 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 200 | x | 0.63 | x | 0.8 | = | 69.4 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 220 | x | 0.63 | x | 0.8 | = | 109.77 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 220 | x | 0.63 | x | 0.8 | = | 76.34 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 206 | x | 0.63 | x | 0.8 | = | 102.79 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 206 | x | 0.63 | x | 0.8 | = | 71.48 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 176 | x | 0.63 | x | 0.8 | = | 87.82 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 176 | x | 0.63 | x | 0.8 | = | 61.07 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 130 | x | 0.63 | x | 0.8 | = | 64.86 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 130 | x | 0.63 | x | 0.8 | = | 45.11 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 76 | x | 0.63 | x | 0.8 | = | 37.92 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 76 | x | 0.63 | x | 0.8 | = | 26.37 | (82) |

# EPC Costs WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rooflights 0.9x | 1 | x | 1.1 | x | 40 | x | 0.63 | x | 0.8 | = | 19.96 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 40 | x | 0.63 | x | 0.8 | = | 13.88 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 26 | x | 0.63 | x | 0.8 | = | 12.97 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 26 | x | 0.63 | x | 0.8 | = | 9.02 | (82) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 88.34 | 158.65 | 283.06 | 463.95 | 596.9 | 667.37 | 620.49 | 514.88 | 365.62 | 208.32 | 109.92 | 72.23 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 593.71 | 660.48 | 767.69 | 921.9 | 1027.68 | 1073.58 | 1012.13 | 913.48 | 779.38 | 648.95 | 580.48 | 565.29 | (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= | 0.9 | 0.87 | 0.8 | 0.66 | 0.5 | 0.33 | 0.23 | 0.26 | 0.49 | 0.74 | 0.86 | 0.91 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.2 | 19.46 | 19.93 | 20.47 | 20.8 | 20.96 | 20.99 | 20.98 | 20.87 | 20.41 | 19.76 | 19.17 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.92 | 19.93 | 19.93 | 19.94 | 19.93 | 19.95 | 19.95 | 19.95 | 19.95 | 19.94 | 19.94 | 19.93 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.89 | 0.85 | 0.78 | 0.63 | 0.45 | 0.27 | 0.16 | 0.18 | 0.42 | 0.69 | 0.84 | 0.9 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.59 | 17.96 | 18.61 | 19.33 | 19.74 | 19.92 | 19.95 | 19.95 | 19.84 | 19.28 | 18.39 | 17.54 | (90) |

fLA = Living area ÷ (4) = 0.31 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.09 | 18.42 | 19.02 | 19.69 | 20.07 | 20.24 | 20.27 | 20.27 | 20.16 | 19.63 | 18.81 | 18.05 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.09 | 18.42 | 19.02 | 19.69 | 20.07 | 20.24 | 20.27 | 20.27 | 20.16 | 19.63 | 18.81 | 18.05 | (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= | 0.86 | 0.83 | 0.75 | 0.62 | 0.45 | 0.28 | 0.18 | 0.2 | 0.43 | 0.68 | 0.81 | 0.87 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 509.92 | 544.93 | 575.82 | 567.32 | 466.95 | 303.9 | 179.39 | 185.03 | 335.1 | 440.96 | 472.16 | 490.97 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 5.1 | 5.7 | 7.4 | 9.9 | 12.9 | 15.8 | 17.7 | 17.6 | 15 | 11.5 | 8 | 5.1 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 944.35 | 918.99 | 839.27 | 699.73 | 514.47 | 313.09 | 181.11 | 187.47 | 363.86 | 581.46 | 770.48 | 931.96 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 323.21 | 251.37 | 196.01 | 95.34 | 35.36 | 0 | 0 | 0 | 0 | 104.53 | 214.8 | 328.1 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1548.71 (98)

Space heating requirement in kWh/m²/year 25.51 (99)

# EPC Costs WorkSheet: New dwelling design stage

## 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) | 323.21 | 251.37 | 196.01 | 95.34 | 35.36 | 0 | 0 | 0 | 0 | 104.53 | 214.8 | 328.1 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 357.54 | 278.07 | 216.83 | 105.46 | 39.11 | 0 | 0 | 0 | 0 | 115.63 | 237.61 | 362.94 | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | | | | | | | | | | | | | 1713.18 (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total (kWh/year) =Sum(215)$_{1...5,10...12}$= | | | | | | | | | | | | | 0 (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 183.55 | 161.97 | 170.55 | 153.51 | 150.88 | 135.46 | 130.71 | 142.59 | 142.07 | 159.15 | 167.51 | 179.34 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 86.46 | 86.15 | 85.4 | 83.89 | 82.04 | 80.3 | 80.3 | 80.3 | 80.3 | 84.02 | 85.68 | 86.55 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 212.29 | 188 | 199.71 | 182.99 | 183.91 | 168.7 | 162.78 | 177.57 | 176.92 | 189.42 | 195.51 | 207.21 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2245 | (219) |

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 1713.18 | |
| Water heating fuel used | | 2245 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| mechanical ventilation - balanced, extract or positive input from outside | 162.02 | | (230a) |
| central heating pump: | 30 | | (230c) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | 192.02 | (231) |
| Electricity for lighting | | 275.11 | (232) |
| Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = | | 4425.3 | (338) |

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

| | **Fuel** kWh/year | **Fuel Price** (Table 12) | | **Fuel Cost** £/year | |
|---|---|---|---|---|---|
| Space heating - main system 1 | (211) x | 3.63 | x 0.01 = | 62.19 | (240) |
| Space heating - main system 2 | (213) x | 0 | x 0.01 = | 0 | (241) |
| Space heating - secondary | (215) x | 19.44 | x 0.01 = | 0 | (242) |

# EPC Costs WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Water heating cost (other fuel) | (219) | 3.63 | x 0.01 = | 81.49 | (247) |
| Pumps, fans and electric keep-hot | (231) | 0 | x 0.01 = | 37.33 | (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) | 0 | x 0.01 = | 53.48 | (250) |
| Additional standing charges (Table 12) | | | | 95 | (251) |

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

| | | | |
|---|---|---|---|
| **Total energy cost** | (245)...(247) + (250)…(254) = | 329.49 | (255) |

## 11a. SAP rating - individual heating systems

| | | | |
|---|---|---|---|
| Energy cost deflator (Table 12) | | 0.42 | (256) |
| Energy cost factor (ECF) | [(255) x (256)] ÷ [(4) + 45.0] = | 1.27 | (257) |
| **SAP rating (Section 12)** | | 82.3 | (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 | = | 370.05 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 484.92 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 854.97 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 99.66 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 142.78 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1097.4 | (272) |
| **Dwelling CO2 Emission Rate** | | (272) ÷ (4) = | | 18.08 | (273) |
| EI rating (section 14) | | | | 86 | (274) |

## 13a. Primary Energy

| | **Energy** kWh/year | **Primary** factor | | **P. Energy** kWh/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 1.22 | = | 2090.08 | (261) |
| Space heating (secondary) | (215) x | 3.07 | = | 0 | (263) |
| Energy for water heating | (219) x | 1.22 | = | 2738.9 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 4828.98 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 3.07 | = | 589.5 | (267) |
| Electricity for lighting | (232) x | 0 | = | 844.58 | (268) |
| 'Total Primary Energy | | sum of (265)…(271) = | | 6263.05 | (272) |
| **Primary energy kWh/m²/year** | | (272) ÷ (4) = | | 103.16 | (273) |

# Code for Sustainable Homes Report

For use with Nov 2010 addendum 2014 England

## Assessor and House Details

**Assessor Name:** Michael Langley
**Assessor Number:** STRO036755
**Property Address:** Flat 16
11-12 Market Place
READING
RG1 2EG

## Buiding regulation assessment

| | kg/m²/year |
|---|---|
| TER | 24.64 |
| DER | 20.47 |

## ENE 1 Assessment - Dwelling Emission Rate

**Total Energy Type $CO_2$ Emissions for Codes Levels 1 - 5**

| | % | kg/m²/year | |
|---|---|---|---|
| DER from SAP 2012 DER Worksheet | | 20.47 | *(ZC1)* |
| TER | | 24.64 | |
| Residual CO2 emissions offset from biofuel CHP | | 0 | *(ZC5)* |
| CO2 emissions offset from additional allowable electricty generation | | 0 | *(ZC7)* |
| Total CO2 emissions offset from SAP Section 16 allowances | | 0 | |
| DER accounting for SAP Section 16 allowances | | 20.47 | |
| % improvement DER/TER | 16.9 | | |

**Total Energy Type CO2 Emissions for Codes Levels 6**

| | kg/m²/year | |
|---|---|---|
| DER accounting for SAP Section 16 allowances | 20.47 | *(ZC1)* |
| CO2 emissions from appliances, equation (L14) | 16.99 | *(ZC2)* |
| CO2 emissions from cooking, equation (L16) | 2.75 | *(ZC3)* |
| Net CO2 emissions | 42.2 | *(ZC8)* |

**Result:**

**Credits awarded for ENE 1 = 2.7**

**Code Level = 3**

## ENE 2 - Fabric energy Efficiency

**Fabric energy Efficiency: 59.57**
**Credits awarded for ENE 2 = 0**

## ENE 7 - Low or Zero Carbon (LZC) Technologies

**Reduction in CO2 Emissions**

| | % | kg/m²/year |
|---|---|---|
| Standard Case CO2 emissions | | 42.24 |
| Standard DER | | 22.5 |
| Actual Case CO2 emissions | | 42.24 |
| Actual DER | | 22.5 |
| Reduction in CO2 emissions | 0 | |

**Credits awarded for ENE 7 = 0**

Technologies eligible to contribute to achieving the requirements of this issue must produce energy from renewable sources and meet all other ancillary requirements as defined by Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

The following requirements must also be met:

- Where not provided by accredited external renewables there must be a direct supply of energy produced to the dwelling under assessment.
- Where covered by the Microgeneration Certification Scheme (MCS), technologies under 50kWe or 300kWth must be certified.
- Combined Heat and Power (CHP) schemes above 50kWe must be certified under the CHPQA standard.
- All technologies must be accounted for by SAP.

CHP schemes fuelled by mains gas are eligible to contribute to performance against this issue. Where these schemes are above 50kWe they must be certified under the CHPQA.

It is the responsibly of the Accredited OCDEA and Code Assessor to ensure all technologies use in the calculation are appropriate before awarding credits.

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Michael Langley | **Stroma Number:** | STRO036755 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.5.51 |

## Property Address: Flat 16 (Be Lean)

**Address :** Flat 16, 11-12 Market Place, READING, RG1 2EG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 60.71 | (1a) x | 3.5 | (2a) = | 212.48 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 60.71 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 212.48 | (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 | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

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

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 1 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.92 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.14 | (21) |

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

# DER WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.18 | 0.17 | 0.17 | 0.15 | 0.15 | 0.13 | 0.13 | 0.13 | 0.14 | 0.15 | 0.16 | 0.16 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.29 | 0.29 | 0.28 | 0.27 | 0.26 | 0.25 | 0.25 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | (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 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.29 | 0.29 | 0.28 | 0.27 | 0.26 | 0.25 | 0.25 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | (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 | | | 2.04 | x 1/[1/( 1 )+ 0.04] | | = | 1.96 | | | (27) |
| Windows Type 2 | | | 2.47 | x 1/[1/( 1 )+ 0.04] | | = | 2.38 | | | (27) |
| Windows Type 3 | | | 2.37 | x 1/[1/( 1 )+ 0.04] | | = | 2.28 | | | (27) |
| Windows Type 4 | | | 2.04 | x1/[1/( 1.2 )+ 0.04] | | = | 2.34 | | | (27) |
| Windows Type 5 | | | 3.81 | x1/[1/( 1.2 )+ 0.04] | | = | 4.36 | | | (27) |
| Rooflights Type 1 | | | 1.1 | x1/[1/(1.2) + 0.04] | | = | 1.32 | | | (27b) |
| Rooflights Type 2 | | | 0.765 | x1/[1/(1.2) + 0.04] | | = | 0.918 | | | (27b) |
| Walls | 76.51 | 12.73 | 63.78 | x | 0.14 | = | 8.93 | | | (29) |
| Roof | 60.71 | 1.87 | 58.84 | x | 0.13 | = | 7.65 | | | (30) |
| Total area of elements, m² | | | 137.22 | | | | | | | (31) |
| Party wall | | | 55.51 | x | 0 | = | 0 | | | (32) |
| Party floor | | | 60.71 | | | | | | | (32a) |
| Internal wall ** | | | 168.16 | | | | | | | (32c) |

** 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) = 32.03 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 6155.66 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 22.29 (36)

# DER WorkSheet: New dwelling design stage

*if details of thermal bridging are not known (36) = 0.05 x (31)*

Total fabric heat loss (33) + (36) = 54.32 (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= | 20.35 | 20.1 | 19.86 | 18.64 | 18.4 | 17.18 | 17.18 | 16.94 | 17.67 | 18.4 | 18.89 | 19.37 | (38) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 74.67 | 74.42 | 74.18 | 72.96 | 72.72 | 71.51 | 71.51 | 71.26 | 71.99 | 72.72 | 73.21 | 73.69 |

Average = Sum(39)$_{1...12}$ /12= 72.9 (39)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.23 | 1.23 | 1.22 | 1.2 | 1.2 | 1.18 | 1.18 | 1.17 | 1.19 | 1.2 | 1.21 | 1.21 |

Average = Sum(40)$_{1...12}$ /12= 1.2 (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 (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 81.74 (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= | 89.91 | 86.64 | 83.37 | 80.1 | 76.83 | 73.56 | 73.56 | 76.83 | 80.1 | 83.37 | 86.64 | 89.91 |

Total = Sum(44)$_{1...12}$ = 980.87 (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= | 133.34 | 116.62 | 120.34 | 104.91 | 100.67 | 86.87 | 80.5 | 92.37 | 93.47 | 108.94 | 118.91 | 129.13 |

Total = Sum(45)$_{1...12}$ = 1286.07 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 20 | 17.49 | 18.05 | 15.74 | 15.1 | 13.03 | 12.07 | 13.86 | 14.02 | 16.34 | 17.84 | 19.37 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (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): 1.61 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.87 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.87 (55)

# DER WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 26.95 | 24.34 | 26.95 | 26.08 | 26.95 | 26.08 | 26.95 | 26.95 | 26.08 | 26.95 | 26.08 | 26.95 | (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= | 26.95 | 24.34 | 26.95 | 26.08 | 26.95 | 26.08 | 26.95 | 26.95 | 26.08 | 26.95 | 26.08 | 26.95 | (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= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (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= | 183.55 | 161.97 | 170.55 | 153.51 | 150.88 | 135.46 | 130.71 | 142.59 | 142.07 | 159.15 | 167.51 | 179.34 | (62) |

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

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

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

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 183.55 | 161.97 | 170.55 | 153.51 | 150.88 | 135.46 | 130.71 | 142.59 | 142.07 | 159.15 | 167.51 | 179.34 |

Output from water heater (annual)$_{1...12}$ | 1877.3 | (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= | 84.51 | 75.06 | 80.18 | 73.76 | 73.64 | 67.76 | 66.94 | 70.88 | 69.96 | 76.39 | 78.41 | 83.11 | (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= | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 15.58 | 13.84 | 11.25 | 8.52 | 6.37 | 5.38 | 5.81 | 7.55 | 10.13 | 12.87 | 15.02 | 16.01 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 174.73 | 176.55 | 171.98 | 162.25 | 149.97 | 138.43 | 130.72 | 128.91 | 133.48 | 143.2 | 155.48 | 167.02 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | (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= | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 113.58 | 111.7 | 107.77 | 102.44 | 98.98 | 94.11 | 89.97 | 95.27 | 97.16 | 102.68 | 108.91 | 111.7 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 359.92 | 358.1 | 347.03 | 329.24 | 311.35 | 293.94 | 282.52 | 287.76 | 296.8 | 314.78 | 335.43 | 350.76 | (73) |

## 6. Solar gains:

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

# DER WorkSheet: New dwelling design stage

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 2.04 | x | 11.28 | x | 0.63 | x | 0.8 | = | 8.04 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 11.28 | x | 0.63 | x | 0.8 | = | 9.73 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 11.28 | x | 0.63 | x | 0.8 | = | 9.34 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 11.28 | x | 0.63 | x | 0.8 | = | 8.04 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 11.28 | x | 0.63 | x | 0.8 | = | 15.01 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 22.97 | x | 0.63 | x | 0.8 | = | 16.36 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 22.97 | x | 0.63 | x | 0.8 | = | 19.81 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 22.97 | x | 0.63 | x | 0.8 | = | 19.01 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 22.97 | x | 0.63 | x | 0.8 | = | 16.36 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 22.97 | x | 0.63 | x | 0.8 | = | 30.56 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 41.38 | x | 0.63 | x | 0.8 | = | 29.48 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 41.38 | x | 0.63 | x | 0.8 | = | 35.7 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 41.38 | x | 0.63 | x | 0.8 | = | 34.25 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 41.38 | x | 0.63 | x | 0.8 | = | 29.48 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 41.38 | x | 0.63 | x | 0.8 | = | 55.06 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 67.96 | x | 0.63 | x | 0.8 | = | 48.42 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 67.96 | x | 0.63 | x | 0.8 | = | 58.63 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 67.96 | x | 0.63 | x | 0.8 | = | 56.25 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 67.96 | x | 0.63 | x | 0.8 | = | 48.42 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 67.96 | x | 0.63 | x | 0.8 | = | 90.43 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.35 | x | 0.63 | x | 0.8 | = | 65.09 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 91.35 | x | 0.63 | x | 0.8 | = | 78.8 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 91.35 | x | 0.63 | x | 0.8 | = | 75.61 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.35 | x | 0.63 | x | 0.8 | = | 65.09 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 91.35 | x | 0.63 | x | 0.8 | = | 121.56 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 97.38 | x | 0.63 | x | 0.8 | = | 69.39 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 97.38 | x | 0.63 | x | 0.8 | = | 84.01 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 97.38 | x | 0.63 | x | 0.8 | = | 80.61 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 97.38 | x | 0.63 | x | 0.8 | = | 69.39 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 97.38 | x | 0.63 | x | 0.8 | = | 129.59 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.1 | x | 0.63 | x | 0.8 | = | 64.91 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 91.1 | x | 0.63 | x | 0.8 | = | 78.59 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 91.1 | x | 0.63 | x | 0.8 | = | 75.41 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.1 | x | 0.63 | x | 0.8 | = | 64.91 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 91.1 | x | 0.63 | x | 0.8 | = | 121.23 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 72.63 | x | 0.63 | x | 0.8 | = | 51.75 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 72.63 | x | 0.63 | x | 0.8 | = | 62.66 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 72.63 | x | 0.63 | x | 0.8 | = | 60.12 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 72.63 | x | 0.63 | x | 0.8 | = | 51.75 | (81) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 3.81 | x | 72.63 | x | 0.63 | x | 0.8 | = | 96.65 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 50.42 | x | 0.63 | x | 0.8 | = | 35.93 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 50.42 | x | 0.63 | x | 0.8 | = | 43.5 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 50.42 | x | 0.63 | x | 0.8 | = | 41.74 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 50.42 | x | 0.63 | x | 0.8 | = | 35.93 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 50.42 | x | 0.63 | x | 0.8 | = | 67.1 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 28.07 | x | 0.63 | x | 0.8 | = | 20 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 28.07 | x | 0.63 | x | 0.8 | = | 24.21 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 28.07 | x | 0.63 | x | 0.8 | = | 23.23 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 28.07 | x | 0.63 | x | 0.8 | = | 20 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 28.07 | x | 0.63 | x | 0.8 | = | 37.35 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 14.2 | x | 0.63 | x | 0.8 | = | 10.12 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 14.2 | x | 0.63 | x | 0.8 | = | 12.25 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 14.2 | x | 0.63 | x | 0.8 | = | 11.75 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 14.2 | x | 0.63 | x | 0.8 | = | 10.12 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 14.2 | x | 0.63 | x | 0.8 | = | 18.89 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 9.21 | x | 0.63 | x | 0.8 | = | 6.57 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 9.21 | x | 0.63 | x | 0.8 | = | 7.95 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 9.21 | x | 0.63 | x | 0.8 | = | 7.63 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 9.21 | x | 0.63 | x | 0.8 | = | 6.57 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 9.21 | x | 0.63 | x | 0.8 | = | 12.26 | (81) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 26 | x | 0.63 | x | 0.8 | = | 12.97 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 26 | x | 0.63 | x | 0.8 | = | 9.02 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 54 | x | 0.63 | x | 0.8 | = | 26.94 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 54 | x | 0.63 | x | 0.8 | = | 18.74 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 96 | x | 0.63 | x | 0.8 | = | 47.9 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 96 | x | 0.63 | x | 0.8 | = | 33.31 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 150 | x | 0.63 | x | 0.8 | = | 74.84 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 150 | x | 0.63 | x | 0.8 | = | 52.05 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 192 | x | 0.63 | x | 0.8 | = | 95.8 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 192 | x | 0.63 | x | 0.8 | = | 66.62 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 200 | x | 0.63 | x | 0.8 | = | 99.79 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 200 | x | 0.63 | x | 0.8 | = | 69.4 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 189 | x | 0.63 | x | 0.8 | = | 94.3 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 189 | x | 0.63 | x | 0.8 | = | 65.58 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 157 | x | 0.63 | x | 0.8 | = | 78.34 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 157 | x | 0.63 | x | 0.8 | = | 54.48 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 115 | x | 0.63 | x | 0.8 | = | 57.38 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 115 | x | 0.63 | x | 0.8 | = | 39.91 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 66 | x | 0.63 | x | 0.8 | = | 32.93 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 66 | x | 0.63 | x | 0.8 | = | 22.9 | (82) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rooflights 0.9x | 1 | x | 1.1 | x | 33 | x | 0.63 | x | 0.8 | = | 16.47 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 33 | x | 0.63 | x | 0.8 | = | 11.45 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 21 | x | 0.63 | x | 0.8 | = | 10.48 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 21 | x | 0.63 | x | 0.8 | = | 7.29 | (82) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 72.16 | 147.8 | 265.19 | 429.04 | 568.57 | 602.19 | 564.94 | 455.73 | 321.47 | 180.63 | 91.04 | 58.73 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 432.08 | 505.9 | 612.22 | 758.28 | 879.92 | 896.13 | 847.47 | 743.49 | 618.26 | 495.4 | 426.47 | 409.5 | (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= | 0.95 | 0.93 | 0.88 | 0.77 | 0.62 | 0.46 | 0.35 | 0.41 | 0.64 | 0.85 | 0.93 | 0.96 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 18.61 | 18.91 | 19.46 | 20.14 | 20.62 | 20.87 | 20.95 | 20.93 | 20.7 | 20.03 | 19.21 | 18.57 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.9 | 19.9 | 19.9 | 19.92 | 19.92 | 19.94 | 19.94 | 19.94 | 19.93 | 19.92 | 19.92 | 19.91 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.95 | 0.92 | 0.86 | 0.74 | 0.57 | 0.4 | 0.27 | 0.33 | 0.57 | 0.82 | 0.92 | 0.95 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 16.73 | 17.17 | 17.94 | 18.88 | 19.51 | 19.83 | 19.91 | 19.9 | 19.65 | 18.77 | 17.61 | 16.67 | (90) |

fLA = Living area ÷ (4) = 0.31 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.31 | 17.71 | 18.41 | 19.27 | 19.86 | 20.15 | 20.23 | 20.22 | 19.97 | 19.16 | 18.1 | 17.26 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.31 | 17.71 | 18.41 | 19.27 | 19.86 | 20.15 | 20.23 | 20.22 | 19.97 | 19.16 | 18.1 | 17.26 | (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= | 0.92 | 0.89 | 0.83 | 0.72 | 0.57 | 0.41 | 0.3 | 0.35 | 0.57 | 0.79 | 0.9 | 0.93 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 398.6 | 451.62 | 509.08 | 543.56 | 499.04 | 368.12 | 250.96 | 258.65 | 354.69 | 393.47 | 381.75 | 380.89 | (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= | 971.21 | 953.03 | 883.31 | 756.69 | 593.05 | 396.91 | 259.69 | 271.92 | 422.75 | 622.31 | 805.57 | 962.13 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 426.02 | 336.95 | 278.43 | 153.46 | 69.94 | 0 | 0 | 0 | 0 | 170.26 | 305.16 | 432.44 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2172.65 (98)

Space heating requirement in kWh/m²/year 35.79 (99)

# DER WorkSheet: New dwelling design stage

## 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) | 426.02 | 336.95 | 278.43 | 153.46 | 69.94 | 0 | 0 | 0 | 0 | 170.26 | 305.16 | 432.44 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 471.26 | 372.73 | 307.99 | 169.75 | 77.37 | 0 | 0 | 0 | 0 | 188.34 | 337.56 | 478.37 | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | | | | | | | | | | | | | 2403.38 (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) | 183.55 | 161.97 | 170.55 | 153.51 | 150.88 | 135.46 | 130.71 | 142.59 | 142.07 | 159.15 | 167.51 | 179.34 | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 (216) |
| (217)m= | 87.1 | 86.85 | 86.28 | 85.05 | 83.25 | 80.3 | 80.3 | 80.3 | 80.3 | 85.22 | 86.54 | 87.19 | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m= | 210.73 | 186.49 | 197.68 | 180.49 | 181.25 | 168.7 | 162.78 | 177.57 | 176.92 | 186.75 | 193.55 | 205.7 | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2228.61 (219) |

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 2403.38 | |
| Water heating fuel used | | 2228.61 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| mechanical ventilation - balanced, extract or positive input from outside | 162.02 | | (230a) |
| central heating pump: | 30 | | (230c) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | 192.02 | (231) |
| Electricity for lighting | | 275.11 | (232) |
| Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = | | 5099.12 | (338) |

## 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 | = | 519.13 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 481.38 | (264) |

# DER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1000.51 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 99.66 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 142.78 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1242.95 | (272) |
| **Dwelling CO2 Emission Rate** | | (272) ÷ (4) = | | 20.47 | (273) |
| EI rating (section 14) | | | | 84 | (274) |

# Developer Confirmation Report

## Property Details: Flat 16 (Be Lean)

| | |
|---|---|
| Address: | Flat 16, 11-12 Market Place, READING, RG1 2EG |
| Located in: | England |
| Region: | Thames valley |
| UPRN: | UPRN-000310041680 |
| Date of assessment: | 06 June 2022 |
| Date of certificate: | 09 June 2022 |
| Assessment type: | New dwelling design stage |
| Transaction type: | New dwelling |
| Thermal Mass Parameter: | Indicative Value Low |

Comments:

## Property description:

| | |
|---|---|
| Dwelling type: | Flat |
| Detachment: | |
| Year Completed: | 2022 |
| Front of dwelling faces: | East |

Comments:

## Opening types:

| Name: | Type: | Frame Factor: | g-value: | U-Value: | Area: |
|---|---|---|---|---|---|
| NW Glazing 01 | Windows | 0.8 | 0.63 | 1 | 2.04 |
| NW Glazing 02 | Windows | 0.8 | 0.63 | 1 | 2.47 |
| NW Glazing 03 | Windows | 0.8 | 0.63 | 1 | 2.37 |
| NW Glazed Door 01 | Windows | 0.8 | 0.63 | 1.2 | 2.04 |
| NW Glazed Door 02 | Windows | 0.8 | 0.63 | 1.2 | 3.81 |
| H Rooflight 01 | Roof Windows | 0.8 | 0.63 | 1.2 | 1.1 |
| H Rooflight 02 | Roof Windows | 0.8 | 0.63 | 1.2 | 0.765 |

Overshading: Average or unknown

Comments:

## Opaque Elements:

| Type: | U-Value: | | Kappa: |
|---|---|---|---|
| External Elements | | | |
| External Improved Brick Cavity Wall | 0.14 | Please provide the U-Value calculation to justify the U-Value entered into the assessment. | N/A |

# Developer Confirmation Report

Materials Used:

| Type: | Name: | Thickness: | Conductivity: | R-Value: |
|---|---|---|---|---|
| External Improved Brick Cavity Walls | Internal Surface Resistance | 0 | 0 | 0.13 |
| External Improved Brick Cavity Walls | Plaster Skim (3 mm) | 3 | 0.18 | 0.02 |
| External Improved Brick Cavity Walls | Plasterboard (12.5 mm) | 12.5 | 0.21 | 0.06 |
| External Improved Brick Cavity Walls | Plasterboard (12.5 mm) | 12.5 | 0.21 | 0.06 |
| External Improved Brick Cavity Walls | Cavity (5 mm) | 5 | 0 | 0.44 |
| External Improved Brick Cavity Walls | FrameTherm 32 (140 mm) | 140 | 0.032 | 4.38 |
| External Improved Brick Cavity Walls | FrameTherm 32 (90 mm) | 90 | 0.032 | 2.81 |
| External Improved Brick Cavity Walls | Brickwork, Inner Leaf (125 mm) | 125 | 0.56 | 0.22 |
| External Improved Brick Cavity Walls | Cavity (50 mm) | 50 | 0 | 0.18 |
| External Improved Brick Cavity Walls | Brickwork, Outer Leaf (125 mm) | 125 | 0.77 | 0.16 |
| External Improved Brick Cavity Walls | External Surface Resistance | 0 | 0 | 0.04 |

Comments:

External Improved Flat Roofs 0.13 Please provide the U-Value calculation to justify the U-Value entered into the assessment. N/A

Materials Used:

| Type: | Name: | Thickness: | Conductivity: | R-Value: |
|---|---|---|---|---|
| External Improved Flat Roofs | Internal Surface Resistance | 0 | 0 | 0.1 |
| External Improved Flat Roofs | Plaster Skim (3 mm) | 3 | 0.18 | 0.02 |
| External Improved Flat Roofs | Plasterboard Standard (12.5 mm) | 12.5 | 0.21 | 0.06 |
| External Improved Flat Roofs | Roof Joists/Airspace (250 mm) | 250 | 0 | 0.16 |
| External Improved Flat Roofs | Plywood (Hardwood) (18 mm) | 18 | 0.18 | 0.1 |
| External Improved Flat Roofs | Vapour Control Membrane (1 mm) | 1 | 1 | 0 |
| External Improved Flat Roofs | Kingspan TR27 Insulation Boards (175 mm) | 175 | 0.024 | 7.29 |
| External Improved Flat Roofs | Fleece Underlay (1 mm) | 1 | 1 | 0 |
| External Improved Flat Roofs | Sika-Trocal Membrane (1 mm) | 1 | 1 | 0 |
| External Improved Flat Roofs | External Surface Resistance | 0 | 0 | 0.04 |

Comments:

Internal Elements (Area, Kappa)

Internal Stud Walls 168.16 N/A

Comments:

Party Elements (Area, Kappa)

Party Stud Walls 55.51 N/A

Comments:

# Developer Confirmation Report

| | | |
|---|---|---|
| Party Plank Floors | 60.71 | N/A |

Comments:

## Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.1625

| | Length | Psi-value | | |
|---|---|---|---|---|
| [Approved] | 5.92 | 0.3 | E2 | Other lintels (including other steel lintels) |
| [Approved] | 5.92 | 0.04 | E3 | Sill |
| [Approved] | 21.5 | 0.05 | E4 | Jamb |
| [Approved] | 21.86 | 0.07 | E7 | Party floor between dwellings (in blocks of flats) |
| | 21.86 | 0.56 | E15 | Flat roof with parapet |
| [Approved] | 7 | 0.09 | E16 | Corner (normal) |
| [Approved] | 7 | 0.06 | E18 | Party wall between dwellings |
| | 15.86 | 0 | P3 | Intermediate floor between dwellings (in blocks of flats) |
| | 15.86 | 0.24 | P4 | Roof (insulation at ceiling level) |
| | 1.95 | 0.08 | R1 | Head |
| | 1.95 | 0.06 | R2 | Sill |
| | 3.8 | 0.08 | R3 | Jamb |

Comments:

If specific construction details have been adopted then please provide the associated checklists; signed and dated.

## Ventilation:

Pressure test: Yes (As designed)

Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 2
Ductwork: Insulation, rigid
Approved Installation Scheme: True

Pressure test: 3

Comments:

Please provide the pressure test certificate, or certificates if the result is based on an average; signed and dated.

## Main heating system:

Main heating system: Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: Manufacturer Declaration
Manufacturer's data
Efficiency: 89.5% (SEDBUK2009)
Regular condensing with automatic ignition
Fuel Burning Type: Unknown
Systems with radiators

# Developer Confirmation Report

Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Unknown
Boiler interlock: Yes

Comments:

## Main heating Control:

Main heating Control:

Time and temperature zone control by device in database

Comments:

## Secondary heating system:

Secondary heating system: None

Comments:

## Water heating:

Water heating:

Hot water cylinder
Cylinder volume: 250 litres
Cylinder insulation: Measured loss, 1.61kWh/day
Primary pipework insulation: True
Cylinderstat: True
Cylinder in heated space: True

Comments:

Solar panel: False

## Others:

| | |
|---|---|
| Electricity tariff: | Standard Tariff |
| Low energy lights: | 100% |
| Terrain type: | Dense urban |
| Wind turbine: | No |

# Developer Confirmation Report

Photovoltaics: None

Comments:

Please provide the MCS certificate or data sheet equivalent confirming the size of the array on the roof. This should include any calculations to support a proportioned amount included in the assessment.

## Declaration :

I confirm that the property has been built to the above specification.

Signed:

.....

Date:

.....

# SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 09 June 2022

## Property Details: Flat 16 (Be Lean)

| | |
|---|---|
| **Dwelling type:** | Flat |
| **Located in:** | England |
| **Region:** | Thames valley |
| **Cross ventilation possible:** | No |
| **Number of storeys:** | 1 |
| **Front of dwelling faces:** | East |
| **Overshading:** | Average or unknown |
| **Overhangs:** | None |
| **Thermal mass parameter:** | Indicative Value Low |
| **Night ventilation:** | True |
| **Blinds, curtains, shutters:** | None |
| **Ventilation rate during hot weather (ach):** | 4 ( Windows fully open) |

## Overheating Details:

| | | |
|---|---|---|
| **Summer ventilation heat loss coefficient:** | 280.48 | **(P1)** |
| **Transmission heat loss coefficient:** | 54.3 | |
| **Summer heat loss coefficient:** | 334.8 | **(P2)** |

## Overhangs:

| **Orientation:** | **Ratio:** | **Z_overhangs:** |
|---|---|---|
| North West (NW Glazing 01) | 0 | 1 |
| North West (NW Glazing 02) | 0 | 1 |
| North West (NW Glazing 03) | 0 | 1 |
| North West (NW Glazed Door 01) | 0 | 1 |
| North West (NW Glazed Door 02) | 0 | 1 |
| Horizontal (H Rooflight 01) | 0 | 1 |
| Horizontal (H Rooflight 02) | 0 | 1 |

## Solar shading:

| **Orientation:** | **Z blinds:** | **Solar access:** | **Overhangs:** | **Z summer:** | |
|---|---|---|---|---|---|
| North West (NW Glazing 01) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (NW Glazing 02) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (NW Glazing 03) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (NW Glazed Door 01) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (NW Glazed Door 02) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| Horizontal (H Rooflight 01) | 1 | 1 | 1 | 1 | **(P8)** |
| Horizontal (H Rooflight 02) | 1 | 1 | 1 | 1 | **(P8)** |

## Solar gains:

| **Orientation** | | **Area** | **Flux** | **g_** | **FF** | **Shading** | **Gains** | |
|---|---|---|---|---|---|---|---|---|
| North West (NW Glazing 01) | 1 x | 2.04 | 98.85 | 0.63 | 0.8 | 0.9 | 82.32 | |
| North West (NW Glazing 02) | 1 x | 2.47 | 98.85 | 0.63 | 0.8 | 0.9 | 99.67 | |
| North West (NW Glazing 03) | 1 x | 2.37 | 98.85 | 0.63 | 0.8 | 0.9 | 95.64 | |
| North West (NW Glazed Door 01) | 1 x | 2.04 | 98.85 | 0.63 | 0.8 | 0.9 | 82.32 | |
| North West (NW Glazed Door 02) | 1 x | 3.81 | 98.85 | 0.63 | 0.8 | 0.9 | 153.74 | |
| | 1 x | 1.1 | 203 | 0.63 | 0.8 | 1 | 101.29 | |
| | 1 x | 0.76 | 203 | 0.63 | 0.8 | 1 | 70.44 | |
| | | | | | | **Total** | 685.42 | **(P3/P4)** |

## Internal gains:

| | **June** | **July** | **August** | |
|---|---|---|---|---|
| Internal gains | 403.21 | 388.64 | 395.6 | |
| Total summer gains | 1141.33 | 1074.06 | 962.21 | **(P5)** |

# SAP 2012 Overheating Assessment

| | | | | |
|---|---|---|---|---|
| Summer gain/loss ratio | 3.41 | 3.21 | 2.87 | **(P6)** |
| Mean summer external temperature (Thames valley) | 16 | 17.9 | 17.8 | |
| Thermal mass temperature increment | 1.3 | 1.3 | 1.3 | |
| Threshold temperature | 20.71 | 22.41 | 21.97 | **(P7)** |
| **Likelihood of high internal temperature** | **Slight** | **Medium** | **Slight** | |

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

# Predicted Energy Assessment

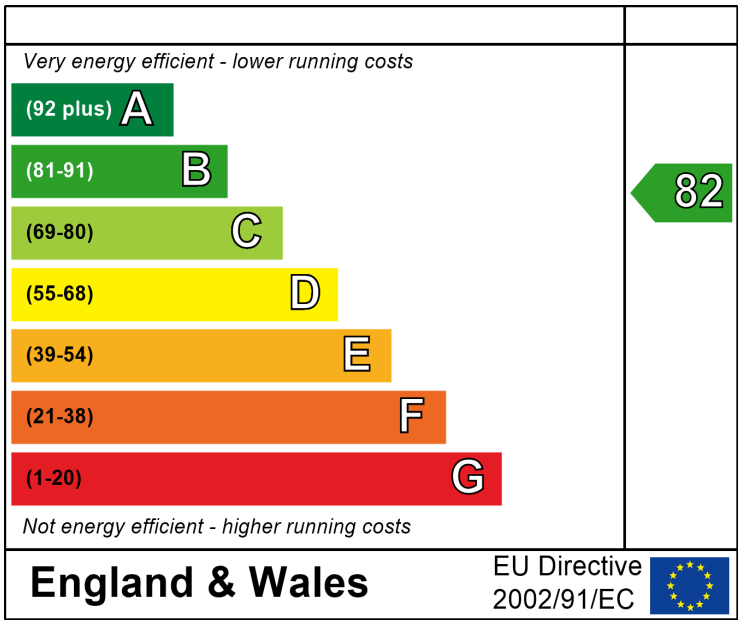
Flat 16
11-12 Market Place
READING
RG1 2EG

| | |
|---|---|
| Dwelling type: | Top floor Flat |
| Date of assessment: | 06 June 2022 |
| Produced by: | Michael Langley |
| Total floor area: | 60.71 m² |

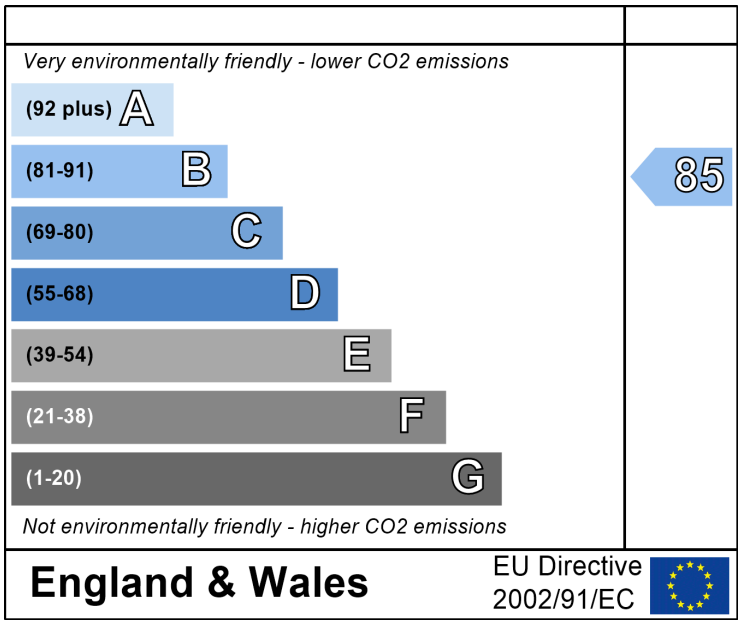
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

## Energy Efficiency Rating




## Environmental Impact ($CO_2$) Rating




The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

# DFEE WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Michael Langley | **Stroma Number:** | STRO036755 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.5.51 |

## Property Address: Flat 16 (Be Lean)

**Address :** Flat 16, 11-12 Market Place, READING, RG1 2EG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 60.71 | (1a) x | 3.5 | (2a) = | 212.48 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 60.71 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 212.48 | (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) = | 0.09 | (8) |

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

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.24 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 1 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.92 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.23 | (21) |

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

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 |

# DFEE WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.29 | 0.28 | 0.28 | 0.25 | 0.24 | 0.21 | 0.21 | 0.21 | 0.23 | 0.24 | 0.25 | 0.27 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

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

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

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

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 2.04 | x 1/[1/( 1 )+ 0.04] | | = | 1.96 | | | (27) |
| Windows Type 2 | | | 2.47 | x 1/[1/( 1 )+ 0.04] | | = | 2.38 | | | (27) |
| Windows Type 3 | | | 2.37 | x 1/[1/( 1 )+ 0.04] | | = | 2.28 | | | (27) |
| Windows Type 4 | | | 2.04 | x1/[1/( 1.2 )+ 0.04] | | = | 2.34 | | | (27) |
| Windows Type 5 | | | 3.81 | x1/[1/( 1.2 )+ 0.04] | | = | 4.36 | | | (27) |
| Rooflights Type 1 | | | 1.1 | x1/[1/(1.2) + 0.04] | | = | 1.32 | | | (27b) |
| Rooflights Type 2 | | | 0.765 | x1/[1/(1.2) + 0.04] | | = | 0.918 | | | (27b) |
| Walls | 76.51 | 12.73 | 63.78 | x | 0.14 | = | 8.93 | | | (29) |
| Roof | 60.71 | 1.87 | 58.84 | x | 0.13 | = | 7.65 | | | (30) |
| Total area of elements, m² | | | 137.22 | | | | | | | (31) |
| Party wall | | | 55.51 | x | 0 | = | 0 | | | (32) |
| Party floor | | | 60.71 | | | | | | | (32a) |
| Internal wall ** | | | 168.16 | | | | | | | (32c) |

** 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) = 32.03 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 6155.66 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 22.29 (36)

# DFEE WorkSheet: New dwelling design stage

*if details of thermal bridging are not known (36) = 0.05 x (31)*

Total fabric heat loss (33) + (36) = 54.32 (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= | 37.97 | 37.85 | 37.74 | 37.22 | 37.13 | 36.67 | 36.67 | 36.59 | 36.85 | 37.13 | 37.32 | 37.53 | (38) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 92.29 | 92.17 | 92.06 | 91.54 | 91.45 | 90.99 | 90.99 | 90.91 | 91.17 | 91.45 | 91.64 | 91.85 |

Average = Sum(39)$_{1...12}$ /12= 91.54 (39)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.52 | 1.52 | 1.52 | 1.51 | 1.51 | 1.5 | 1.5 | 1.5 | 1.5 | 1.51 | 1.51 | 1.51 |

Average = Sum(40)$_{1...12}$ /12= 1.51 (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 (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 81.74 (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= | 89.91 | 86.64 | 83.37 | 80.1 | 76.83 | 73.56 | 73.56 | 76.83 | 80.1 | 83.37 | 86.64 | 89.91 |

Total = Sum(44)$_{1...12}$ = 980.87 (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= | 133.34 | 116.62 | 120.34 | 104.91 | 100.67 | 86.87 | 80.5 | 92.37 | 93.47 | 108.94 | 118.91 | 129.13 |

Total = Sum(45)$_{1...12}$ = 1286.07 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

# DFEE WorkSheet: New dwelling design stage

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= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (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= | 113.34 | 99.13 | 102.29 | 89.18 | 85.57 | 73.84 | 68.42 | 78.52 | 79.45 | 92.6 | 101.08 | 109.76 | (62) |

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

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

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

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 113.34 | 99.13 | 102.29 | 89.18 | 85.57 | 73.84 | 68.42 | 78.52 | 79.45 | 92.6 | 101.08 | 109.76 |

Output from water heater (annual)$_{1...12}$ | 1093.16 | (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= | 28.33 | 24.78 | 25.57 | 22.29 | 21.39 | 18.46 | 17.11 | 19.63 | 19.86 | 23.15 | 25.27 | 27.44 | (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= | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 15.58 | 13.84 | 11.25 | 8.52 | 6.37 | 5.38 | 5.81 | 7.55 | 10.13 | 12.87 | 15.02 | 16.01 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 174.73 | 176.55 | 171.98 | 162.25 | 149.97 | 138.43 | 130.72 | 128.91 | 133.48 | 143.2 | 155.48 | 167.02 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 38.08 | 36.88 | 34.37 | 30.96 | 28.75 | 25.64 | 22.99 | 26.38 | 27.59 | 31.11 | 35.1 | 36.88 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 281.42 | 280.28 | 270.63 | 254.76 | 238.12 | 222.47 | 212.55 | 215.87 | 224.22 | 240.21 | 258.62 | 272.94 | (73) |

## 6. Solar gains:

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

# DFEE WorkSheet: New dwelling design stage

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 2.04 | x | 11.28 | x | 0.63 | x | 0.8 | = | 8.04 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 11.28 | x | 0.63 | x | 0.8 | = | 9.73 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 11.28 | x | 0.63 | x | 0.8 | = | 9.34 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 11.28 | x | 0.63 | x | 0.8 | = | 8.04 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 11.28 | x | 0.63 | x | 0.8 | = | 15.01 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 22.97 | x | 0.63 | x | 0.8 | = | 16.36 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 22.97 | x | 0.63 | x | 0.8 | = | 19.81 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 22.97 | x | 0.63 | x | 0.8 | = | 19.01 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 22.97 | x | 0.63 | x | 0.8 | = | 16.36 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 22.97 | x | 0.63 | x | 0.8 | = | 30.56 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 41.38 | x | 0.63 | x | 0.8 | = | 29.48 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 41.38 | x | 0.63 | x | 0.8 | = | 35.7 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 41.38 | x | 0.63 | x | 0.8 | = | 34.25 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 41.38 | x | 0.63 | x | 0.8 | = | 29.48 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 41.38 | x | 0.63 | x | 0.8 | = | 55.06 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 67.96 | x | 0.63 | x | 0.8 | = | 48.42 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 67.96 | x | 0.63 | x | 0.8 | = | 58.63 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 67.96 | x | 0.63 | x | 0.8 | = | 56.25 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 67.96 | x | 0.63 | x | 0.8 | = | 48.42 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 67.96 | x | 0.63 | x | 0.8 | = | 90.43 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.35 | x | 0.63 | x | 0.8 | = | 65.09 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 91.35 | x | 0.63 | x | 0.8 | = | 78.8 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 91.35 | x | 0.63 | x | 0.8 | = | 75.61 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.35 | x | 0.63 | x | 0.8 | = | 65.09 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 91.35 | x | 0.63 | x | 0.8 | = | 121.56 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 97.38 | x | 0.63 | x | 0.8 | = | 69.39 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 97.38 | x | 0.63 | x | 0.8 | = | 84.01 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 97.38 | x | 0.63 | x | 0.8 | = | 80.61 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 97.38 | x | 0.63 | x | 0.8 | = | 69.39 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 97.38 | x | 0.63 | x | 0.8 | = | 129.59 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.1 | x | 0.63 | x | 0.8 | = | 64.91 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 91.1 | x | 0.63 | x | 0.8 | = | 78.59 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 91.1 | x | 0.63 | x | 0.8 | = | 75.41 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.1 | x | 0.63 | x | 0.8 | = | 64.91 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 91.1 | x | 0.63 | x | 0.8 | = | 121.23 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 72.63 | x | 0.63 | x | 0.8 | = | 51.75 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 72.63 | x | 0.63 | x | 0.8 | = | 62.66 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 72.63 | x | 0.63 | x | 0.8 | = | 60.12 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 72.63 | x | 0.63 | x | 0.8 | = | 51.75 | (81) |

# DFEE WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 3.81 | x | 72.63 | x | 0.63 | x | 0.8 | = | 96.65 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 50.42 | x | 0.63 | x | 0.8 | = | 35.93 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 50.42 | x | 0.63 | x | 0.8 | = | 43.5 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 50.42 | x | 0.63 | x | 0.8 | = | 41.74 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 50.42 | x | 0.63 | x | 0.8 | = | 35.93 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 50.42 | x | 0.63 | x | 0.8 | = | 67.1 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 28.07 | x | 0.63 | x | 0.8 | = | 20 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 28.07 | x | 0.63 | x | 0.8 | = | 24.21 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 28.07 | x | 0.63 | x | 0.8 | = | 23.23 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 28.07 | x | 0.63 | x | 0.8 | = | 20 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 28.07 | x | 0.63 | x | 0.8 | = | 37.35 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 14.2 | x | 0.63 | x | 0.8 | = | 10.12 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 14.2 | x | 0.63 | x | 0.8 | = | 12.25 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 14.2 | x | 0.63 | x | 0.8 | = | 11.75 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 14.2 | x | 0.63 | x | 0.8 | = | 10.12 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 14.2 | x | 0.63 | x | 0.8 | = | 18.89 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 9.21 | x | 0.63 | x | 0.8 | = | 6.57 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 9.21 | x | 0.63 | x | 0.8 | = | 7.95 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 9.21 | x | 0.63 | x | 0.8 | = | 7.63 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 9.21 | x | 0.63 | x | 0.8 | = | 6.57 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 9.21 | x | 0.63 | x | 0.8 | = | 12.26 | (81) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 26 | x | 0.63 | x | 0.8 | = | 12.97 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 26 | x | 0.63 | x | 0.8 | = | 9.02 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 54 | x | 0.63 | x | 0.8 | = | 26.94 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 54 | x | 0.63 | x | 0.8 | = | 18.74 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 96 | x | 0.63 | x | 0.8 | = | 47.9 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 96 | x | 0.63 | x | 0.8 | = | 33.31 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 150 | x | 0.63 | x | 0.8 | = | 74.84 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 150 | x | 0.63 | x | 0.8 | = | 52.05 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 192 | x | 0.63 | x | 0.8 | = | 95.8 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 192 | x | 0.63 | x | 0.8 | = | 66.62 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 200 | x | 0.63 | x | 0.8 | = | 99.79 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 200 | x | 0.63 | x | 0.8 | = | 69.4 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 189 | x | 0.63 | x | 0.8 | = | 94.3 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 189 | x | 0.63 | x | 0.8 | = | 65.58 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 157 | x | 0.63 | x | 0.8 | = | 78.34 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 157 | x | 0.63 | x | 0.8 | = | 54.48 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 115 | x | 0.63 | x | 0.8 | = | 57.38 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 115 | x | 0.63 | x | 0.8 | = | 39.91 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 66 | x | 0.63 | x | 0.8 | = | 32.93 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 66 | x | 0.63 | x | 0.8 | = | 22.9 | (82) |

# DFEE WorkSheet: New dwelling design stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rooflights 0.9x | 1 | x | 1.1 | x | 33 | x | 0.63 | x | 0.8 | = | 16.47 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 33 | x | 0.63 | x | 0.8 | = | 11.45 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 21 | x | 0.63 | x | 0.8 | = | 10.48 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 21 | x | 0.63 | x | 0.8 | = | 7.29 | (82) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 72.16 | 147.8 | 265.19 | 429.04 | 568.57 | 602.19 | 564.94 | 455.73 | 321.47 | 180.63 | 91.04 | 58.73 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 353.58 | 428.08 | 535.82 | 683.8 | 806.69 | 824.66 | 777.49 | 671.6 | 545.69 | 420.84 | 349.66 | 331.68 | (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= | 0.97 | 0.95 | 0.92 | 0.83 | 0.71 | 0.57 | 0.45 | 0.52 | 0.74 | 0.9 | 0.96 | 0.97 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 17.87 | 18.19 | 18.8 | 19.59 | 20.27 | 20.69 | 20.87 | 20.82 | 20.41 | 19.5 | 18.54 | 17.81 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.67 | 19.67 | 19.68 | 19.68 | 19.68 | 19.69 | 19.69 | 19.69 | 19.69 | 19.68 | 19.68 | 19.68 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.97 | 0.95 | 0.9 | 0.8 | 0.66 | 0.48 | 0.34 | 0.4 | 0.67 | 0.88 | 0.95 | 0.97 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 16.86 | 17.18 | 17.77 | 18.54 | 19.16 | 19.51 | 19.64 | 19.61 | 19.3 | 18.48 | 17.53 | 16.8 | (90) |

fLA = Living area ÷ (4) = 0.31 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.17 | 17.49 | 18.09 | 18.86 | 19.5 | 19.88 | 20.02 | 19.98 | 19.64 | 18.79 | 17.84 | 17.11 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.17 | 17.49 | 18.09 | 18.86 | 19.5 | 19.88 | 20.02 | 19.98 | 19.64 | 18.79 | 17.84 | 17.11 | (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= | 0.95 | 0.93 | 0.88 | 0.78 | 0.65 | 0.49 | 0.37 | 0.43 | 0.66 | 0.86 | 0.93 | 0.96 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 336.35 | 397.31 | 470.98 | 535.02 | 521.83 | 407.82 | 285.65 | 289.03 | 362.28 | 360.48 | 326.35 | 317.4 | (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= | 1188.19 | 1160.53 | 1066.74 | 912.15 | 713.2 | 480.36 | 311.03 | 325.85 | 505.5 | 749.19 | 984.69 | 1186.11 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 633.77 | 512.88 | 443.24 | 271.53 | 142.38 | 0 | 0 | 0 | 0 | 289.2 | 474.01 | 646.32 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3413.32 (98)

Space heating requirement in kWh/m²/year 56.22 (99)

# DFEE WorkSheet: New dwelling design stage

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10) | | | | | | | | | | | | | |
| (100)m= | 0 | 0 | 0 | 0 | 0 | 855.35 | 673.36 | 690.92 | 0 | 0 | 0 | 0 | (100) |
| Utilisation factor for loss hm | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.75 | 0.8 | 0.75 | 0 | 0 | 0 | 0 | (101) |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 638.19 | 539.09 | 521.13 | 0 | 0 | 0 | 0 | (102) |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 1010.03 | 955 | 836.96 | 0 | 0 | 0 | 0 | (103) |

*Space cooling requirement for month, whole dwelling, continuous ( kWh) = 0.024 x [(103)m – (102)m ] x (41)m*
set (104)m to zero if (104)m < 3 × (98)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (104)m= | 0 | 0 | 0 | 0 | 0 | 267.72 | 309.44 | 234.97 | 0 | 0 | 0 | 0 | |

Total = Sum(104) = 812.14 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (106)m= | 0 | 0 | 0 | 0 | 0 | 0.25 | 0.25 | 0.25 | 0 | 0 | 0 | 0 | |

*Total = Sum(104)* = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (107)m= | 0 | 0 | 0 | 0 | 0 | 66.93 | 77.36 | 58.74 | 0 | 0 | 0 | 0 | |

Total = Sum(107) = 203.03 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 3.34 (108)

## 8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 59.57 (109)

# SAP Input

## Property Details: Flat 16 (Be Lean)

| | |
|---|---|
| Address: | Flat 16, 11-12 Market Place, READING, RG1 2EG |
| Located in: | England |
| Region: | Thames valley |
| UPRN: | UPRN-000310041680 |
| Date of assessment: | 06 June 2022 |
| Date of certificate: | 09 June 2022 |
| Assessment type: | New dwelling design stage |
| Transaction type: | New dwelling |
| Tenure type: | Unknown |
| Related party disclosure: | No related party |
| Thermal Mass Parameter: | Indicative Value Low |
| Water use <= 125 litres/person/day: | True |
| PCDF Version: | 497 |

## Property description:

| | | |
|---|---|---|
| Dwelling type: | Flat | |
| Detachment: | | |
| Year Completed: | 2022 | |
| Floor Location: | Floor area: | Storey height: |
| Floor 0 | 60.71 m² | 3.5 m |
| Living area: | 18.74 m² (fraction 0.309) | |
| Front of dwelling faces: | East | |

## Opening types:

| Name: | Source: | Type: | Glazing: | Argon: | Frame: |
|---|---|---|---|---|---|
| NW Glazing 01 | Manufacturer | Windows | double-glazed | No | |
| NW Glazing 02 | Manufacturer | Windows | double-glazed | No | |
| NW Glazing 03 | Manufacturer | Windows | double-glazed | No | |
| NW Glazed Door 01 | Manufacturer | Windows | double-glazed | No | |
| NW Glazed Door 02 | Manufacturer | Windows | double-glazed | No | |
| H Rooflight 01 | Manufacturer | Roof Windows | low-E, En = 0.05, soft coat | No | Metal |
| H Rooflight 02 | Manufacturer | Roof Windows | low-E, En = 0.05, soft coat | No | Metal |

| **Name:** | **Gap:** | **Frame Factor:** | **g-value:** | **U-value:** | **Area:** | **No. of Openings:** |
|---|---|---|---|---|---|---|
| NW Glazing 01 | 16mm or more | 0.8 | 0.63 | 1 | 2.04 | 1 |
| NW Glazing 02 | 16mm or more | 0.8 | 0.63 | 1 | 2.47 | 1 |
| NW Glazing 03 | 16mm or more | 0.8 | 0.63 | 1 | 2.37 | 1 |
| NW Glazed Door 01 | 16mm or more | 0.8 | 0.63 | 1.2 | 2.04 | 1 |
| NW Glazed Door 02 | 16mm or more | 0.8 | 0.63 | 1.2 | 3.81 | 1 |
| H Rooflight 01 | 16mm or more | 0.8 | 0.63 | 1.2 | 1.1 | 1 |
| H Rooflight 02 | 16mm or more | 0.8 | 0.63 | 1.2 | 0.765 | 1 |

| Name: | Type-Name: | Location: | Orient: | Width: | Height: |
|---|---|---|---|---|---|
| NW Glazing 01 | | External Improved Brick Cavity Walls | North West | 0.95 | 2.15 |
| NW Glazing 02 | | External Improved Brick Cavity Walls | North West | 1.15 | 2.15 |
| NW Glazing 03 | | External Improved Brick Cavity Walls | North West | 1.1 | 2.15 |
| NW Glazed Door 01 | | External Improved Brick Cavity Walls | North West | 0.95 | 2.15 |
| NW Glazed Door 02 | | External Improved Brick Cavity Walls | North West | 1.77 | 2.15 |
| H Rooflight 01 | | External Improved Flat Roofs | Horizontal | 1.05 | 1.05 |
| H Rooflight 02 | | External Improved Flat Roofs | Horizontal | 0.9 | 0.85 |

Overshading: Average or unknown

## Opaque Elements:

| Type: | Gross area: | Openings: | Net area: | U-value: | Ru value: | Curtain wall: | Kappa: |
|---|---|---|---|---|---|---|---|

# SAP Input

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **External Elements** | | | | | | | |
| External Improved Brick Cavity Walls | 76.51 | 12.73 | 63.78 | 0.14 | 0 | False | N/A |
| External Improved Flat Roofs | 60.71 | 1.87 | 58.84 | 0.13 | 0 | | N/A |
| **Internal Elements** | | | | | | | |
| Internal Stud Walls | 168.16 | | | | | | N/A |
| **Party Elements** | | | | | | | |
| Party Stud Walls | 55.51 | | | | | | N/A |
| Party Plank Floors | 60.71 | | | | | | N/A |

## Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.1625

| | Length | Psi-value | | |
|---|---|---|---|---|
| [Approved] | 5.92 | 0.3 | E2 | Other lintels (including other steel lintels) |
| [Approved] | 5.92 | 0.04 | E3 | Sill |
| [Approved] | 21.5 | 0.05 | E4 | Jamb |
| [Approved] | 21.86 | 0.07 | E7 | Party floor between dwellings (in blocks of flats) |
| | 21.86 | 0.56 | E15 | Flat roof with parapet |
| [Approved] | 7 | 0.09 | E16 | Corner (normal) |
| [Approved] | 7 | 0.06 | E18 | Party wall between dwellings |
| | 15.86 | 0 | P3 | Intermediate floor between dwellings (in blocks of flats) |
| | 15.86 | 0.24 | P4 | Roof (insulation at ceiling level) |
| | 1.95 | 0.08 | R1 | Head |
| | 1.95 | 0.06 | R2 | Sill |
| | 3.8 | 0.08 | R3 | Jamb |

## Ventilation:

Pressure test: Yes (As designed)

Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 2
Ductwork: Insulation, rigid
Approved Installation Scheme: True

Number of chimneys: 0
Number of open flues: 0
Number of fans: 0
Number of passive stacks: 0
Number of sides sheltered: 1
Pressure test: 3

## Main heating system:

Main heating system: Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: Manufacturer Declaration
Manufacturer's data
Efficiency: 89.5% (SEDBUK2009)
Regular condensing with automatic ignition
Fuel Burning Type: Unknown
Systems with radiators
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Unknown
Boiler interlock: Yes

## Main heating Control:

Main heating Control: Time and temperature zone control by device in database
Control code: 2112

## Secondary heating system:

Secondary heating system: None

# SAP Input

| Water heating: | |
|---|---|
| Water heating: | From main heating system<br>Water code: 901<br>Fuel :mains gas<br>Hot water cylinder<br>Cylinder volume: 250 litres<br>Cylinder insulation: Measured loss, 1.61kWh/day<br>Primary pipework insulation: True<br>Cylinderstat: True<br>Cylinder in heated space: True<br>Solar panel: False |

| Others: | |
|---|---|
| Electricity tariff: | Standard Tariff |
| In Smoke Control Area: | Unknown |
| Conservatory: | No conservatory |
| Low energy lights: | 100% |
| Terrain type: | Dense urban |
| EPC language: | English |
| Wind turbine: | No |
| Photovoltaics: | None |
| Assess Zero Carbon Home: | No |

# TFEE WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Michael Langley | **Stroma Number:** | STRO036755 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.5.51 |

## Property Address: Flat 16 (Be Lean)

**Address :** Flat 16, 11-12 Market Place, READING, RG1 2EG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 60.71 | (1a) x | 3.5 | (2a) = | 212.48 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 60.71 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 212.48 | (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) = | 0.09 | (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) | 0.34 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 1 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.92 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.32 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TFEE WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.41 | 0.4 | 0.39 | 0.35 | 0.34 | 0.3 | 0.3 | 0.29 | 0.32 | 0.34 | 0.36 | 0.37 |

*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= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (24d) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (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 | | | 2.04 | x1/[1/( 1.4 )+ 0.04] | | = | 2.7 | | | (27) |
| Windows Type 2 | | | 2.47 | x1/[1/( 1.4 )+ 0.04] | | = | 3.27 | | | (27) |
| Windows Type 3 | | | 2.37 | x1/[1/( 1.4 )+ 0.04] | | = | 3.14 | | | (27) |
| Windows Type 4 | | | 2.04 | x1/[1/( 1.4 )+ 0.04] | | = | 2.7 | | | (27) |
| Windows Type 5 | | | 3.81 | x1/[1/( 1.4 )+ 0.04] | | = | 5.05 | | | (27) |
| Rooflights Type 1 | | | 1.1 | x1/[1/(1.7) + 0.04] | | = | 1.87 | | | (27b) |
| Rooflights Type 2 | | | 0.765 | x1/[1/(1.7) + 0.04] | | = | 1.3005 | | | (27b) |
| Walls | 76.51 | 12.73 | 63.78 | x | 0.18 | = | 11.48 | | | (29) |
| Roof | 60.71 | 1.87 | 58.84 | x | 0.13 | = | 7.65 | | | (30) |
| Total area of elements, m² | | | 137.22 | | | | | | | (31) |
| Party wall | | | 55.51 | x | 0 | = | 0 | | | (32) |
| Party floor | | | 60.71 | | | | | | | (32a) |
| Internal wall ** | | | 168.16 | | | | | | | (32c) |

** 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) = 38.98 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 6155.66 (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 18.97 (36)

# TFEE WorkSheet: New dwelling design stage

*if details of thermal bridging are not known (36) = 0.05 x (31)*

Total fabric heat loss (33) + (36) = 57.94 (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= | 40.83 | 40.61 | 40.39 | 39.36 | 39.17 | 38.27 | 38.27 | 38.1 | 38.61 | 39.17 | 39.56 | 39.96 | (38) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 98.78 | 98.56 | 98.34 | 97.3 | 97.11 | 96.21 | 96.21 | 96.04 | 96.56 | 97.11 | 97.5 | 97.91 |

Average = Sum(39)$_{1...12}$ /12= 97.3 (39)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.63 | 1.62 | 1.62 | 1.6 | 1.6 | 1.58 | 1.58 | 1.58 | 1.59 | 1.6 | 1.61 | 1.61 |

Average = Sum(40)$_{1...12}$ /12= 1.6 (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 (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 81.74 (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= | 89.91 | 86.64 | 83.37 | 80.1 | 76.83 | 73.56 | 73.56 | 76.83 | 80.1 | 83.37 | 86.64 | 89.91 |

Total = Sum(44)$_{1...12}$ = 980.87 (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= | 133.34 | 116.62 | 120.34 | 104.91 | 100.67 | 86.87 | 80.5 | 92.37 | 93.47 | 108.94 | 118.91 | 129.13 |

Total = Sum(45)$_{1...12}$ = 1286.07 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

# TFEE WorkSheet: New dwelling design stage

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= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (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= | 113.34 | 99.13 | 102.29 | 89.18 | 85.57 | 73.84 | 68.42 | 78.52 | 79.45 | 92.6 | 101.08 | 109.76 | (62) |

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

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

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

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 113.34 | 99.13 | 102.29 | 89.18 | 85.57 | 73.84 | 68.42 | 78.52 | 79.45 | 92.6 | 101.08 | 109.76 |

Output from water heater (annual)$_{1...12}$ | 1093.16 | (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= | 28.33 | 24.78 | 25.57 | 22.29 | 21.39 | 18.46 | 17.11 | 19.63 | 19.86 | 23.15 | 25.27 | 27.44 | (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= | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 15.58 | 13.84 | 11.25 | 8.52 | 6.37 | 5.38 | 5.81 | 7.55 | 10.13 | 12.87 | 15.02 | 16.01 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 174.73 | 176.55 | 171.98 | 162.25 | 149.97 | 138.43 | 130.72 | 128.91 | 133.48 | 143.2 | 155.48 | 167.02 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 38.08 | 36.88 | 34.37 | 30.96 | 28.75 | 25.64 | 22.99 | 26.38 | 27.59 | 31.11 | 35.1 | 36.88 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 281.42 | 280.28 | 270.63 | 254.76 | 238.12 | 222.47 | 212.55 | 215.87 | 224.22 | 240.21 | 258.62 | 272.94 | (73) |

## 6. Solar gains:

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

# TFEE WorkSheet: New dwelling design stage

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 2.04 | x | 11.28 | x | 0.63 | x | 0.7 | = | 7.03 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 11.28 | x | 0.63 | x | 0.7 | = | 8.52 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 11.28 | x | 0.63 | x | 0.7 | = | 8.17 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 11.28 | x | 0.63 | x | 0.7 | = | 7.03 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 11.28 | x | 0.63 | x | 0.7 | = | 13.14 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 22.97 | x | 0.63 | x | 0.7 | = | 14.32 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 22.97 | x | 0.63 | x | 0.7 | = | 17.34 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 22.97 | x | 0.63 | x | 0.7 | = | 16.63 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 22.97 | x | 0.63 | x | 0.7 | = | 14.32 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 22.97 | x | 0.63 | x | 0.7 | = | 26.74 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 41.38 | x | 0.63 | x | 0.7 | = | 25.8 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 41.38 | x | 0.63 | x | 0.7 | = | 31.24 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 41.38 | x | 0.63 | x | 0.7 | = | 29.97 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 41.38 | x | 0.63 | x | 0.7 | = | 25.8 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 41.38 | x | 0.63 | x | 0.7 | = | 48.18 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 67.96 | x | 0.63 | x | 0.7 | = | 42.37 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 67.96 | x | 0.63 | x | 0.7 | = | 51.3 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 67.96 | x | 0.63 | x | 0.7 | = | 49.22 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 67.96 | x | 0.63 | x | 0.7 | = | 42.37 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 67.96 | x | 0.63 | x | 0.7 | = | 79.13 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.35 | x | 0.63 | x | 0.7 | = | 56.95 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 91.35 | x | 0.63 | x | 0.7 | = | 68.95 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 91.35 | x | 0.63 | x | 0.7 | = | 66.16 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.35 | x | 0.63 | x | 0.7 | = | 56.95 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 91.35 | x | 0.63 | x | 0.7 | = | 106.36 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 97.38 | x | 0.63 | x | 0.7 | = | 60.71 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 97.38 | x | 0.63 | x | 0.7 | = | 73.51 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 97.38 | x | 0.63 | x | 0.7 | = | 70.54 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 97.38 | x | 0.63 | x | 0.7 | = | 60.71 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 97.38 | x | 0.63 | x | 0.7 | = | 113.39 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.1 | x | 0.63 | x | 0.7 | = | 56.8 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 91.1 | x | 0.63 | x | 0.7 | = | 68.77 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 91.1 | x | 0.63 | x | 0.7 | = | 65.98 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.1 | x | 0.63 | x | 0.7 | = | 56.8 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 91.1 | x | 0.63 | x | 0.7 | = | 106.08 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 72.63 | x | 0.63 | x | 0.7 | = | 45.28 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 72.63 | x | 0.63 | x | 0.7 | = | 54.82 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 72.63 | x | 0.63 | x | 0.7 | = | 52.6 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 72.63 | x | 0.63 | x | 0.7 | = | 45.28 | (81) |

# TFEE WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 3.81 | x | 72.63 | x | 0.63 | x | 0.7 | = | 84.57 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 50.42 | x | 0.63 | x | 0.7 | = | 31.43 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 50.42 | x | 0.63 | x | 0.7 | = | 38.06 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 50.42 | x | 0.63 | x | 0.7 | = | 36.52 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 50.42 | x | 0.63 | x | 0.7 | = | 31.43 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 50.42 | x | 0.63 | x | 0.7 | = | 58.71 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 28.07 | x | 0.63 | x | 0.7 | = | 17.5 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 28.07 | x | 0.63 | x | 0.7 | = | 21.19 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 28.07 | x | 0.63 | x | 0.7 | = | 20.33 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 28.07 | x | 0.63 | x | 0.7 | = | 17.5 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 28.07 | x | 0.63 | x | 0.7 | = | 32.68 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 14.2 | x | 0.63 | x | 0.7 | = | 8.85 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 14.2 | x | 0.63 | x | 0.7 | = | 10.72 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 14.2 | x | 0.63 | x | 0.7 | = | 10.28 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 14.2 | x | 0.63 | x | 0.7 | = | 8.85 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 14.2 | x | 0.63 | x | 0.7 | = | 16.53 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 9.21 | x | 0.63 | x | 0.7 | = | 5.74 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 9.21 | x | 0.63 | x | 0.7 | = | 6.96 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 9.21 | x | 0.63 | x | 0.7 | = | 6.67 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 9.21 | x | 0.63 | x | 0.7 | = | 5.74 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 9.21 | x | 0.63 | x | 0.7 | = | 10.73 | (81) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 26 | x | 0.63 | x | 0.7 | = | 11.35 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 26 | x | 0.63 | x | 0.7 | = | 7.89 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 54 | x | 0.63 | x | 0.7 | = | 23.58 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 54 | x | 0.63 | x | 0.7 | = | 16.4 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 96 | x | 0.63 | x | 0.7 | = | 41.91 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 96 | x | 0.63 | x | 0.7 | = | 29.15 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 150 | x | 0.63 | x | 0.7 | = | 65.49 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 150 | x | 0.63 | x | 0.7 | = | 45.54 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 192 | x | 0.63 | x | 0.7 | = | 83.83 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 192 | x | 0.63 | x | 0.7 | = | 58.3 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 200 | x | 0.63 | x | 0.7 | = | 87.32 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 200 | x | 0.63 | x | 0.7 | = | 60.73 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 189 | x | 0.63 | x | 0.7 | = | 82.52 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 189 | x | 0.63 | x | 0.7 | = | 57.39 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 157 | x | 0.63 | x | 0.7 | = | 68.54 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 157 | x | 0.63 | x | 0.7 | = | 47.67 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 115 | x | 0.63 | x | 0.7 | = | 50.21 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 115 | x | 0.63 | x | 0.7 | = | 34.92 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 66 | x | 0.63 | x | 0.7 | = | 28.81 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 66 | x | 0.63 | x | 0.7 | = | 20.04 | (82) |

# TFEE WorkSheet: New dwelling design stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rooflights 0.9x | 1 | x | 1.1 | x | 33 | x | 0.63 | x | 0.7 | = | 14.41 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 33 | x | 0.63 | x | 0.7 | = | 10.02 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 21 | x | 0.63 | x | 0.7 | = | 9.17 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 21 | x | 0.63 | x | 0.7 | = | 6.38 | (82) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 63.14 | 129.32 | 232.04 | 375.41 | 497.5 | 526.91 | 494.33 | 398.77 | 281.28 | 158.05 | 79.66 | 51.39 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 344.56 | 409.61 | 502.67 | 630.17 | 735.62 | 749.38 | 706.87 | 614.63 | 505.51 | 398.26 | 338.28 | 324.33 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.96 | 0.87 | 0.71 | 0.56 | 0.65 | 0.89 | 0.98 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.14 | 19.32 | 19.68 | 20.18 | 20.62 | 20.88 | 20.96 | 20.94 | 20.69 | 20.12 | 19.55 | 19.12 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.59 | 19.6 | 19.6 | 19.61 | 19.61 | 19.62 | 19.62 | 19.63 | 19.62 | 19.61 | 19.61 | 19.6 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.94 | 0.81 | 0.6 | 0.4 | 0.49 | 0.82 | 0.97 | 1 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.93 | 18.11 | 18.47 | 18.97 | 19.37 | 19.57 | 19.62 | 19.61 | 19.45 | 18.92 | 18.35 | 17.91 | (90) |

fLA = Living area ÷ (4) = 0.31 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.31 | 18.49 | 18.84 | 19.34 | 19.76 | 19.98 | 20.03 | 20.02 | 19.83 | 19.29 | 18.72 | 18.28 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.31 | 18.49 | 18.84 | 19.34 | 19.76 | 19.98 | 20.03 | 20.02 | 19.83 | 19.29 | 18.72 | 18.28 | (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 | 0.98 | 0.93 | 0.82 | 0.63 | 0.45 | 0.54 | 0.83 | 0.97 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 343.33 | 406.63 | 492.71 | 588.81 | 602.78 | 472.75 | 321.16 | 330.6 | 419.96 | 386.66 | 336.1 | 323.42 | (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= | 1383.48 | 1339.01 | 1213.55 | 1015.99 | 782.34 | 517.46 | 330.28 | 347.78 | 553.43 | 843.59 | 1132.72 | 1379.04 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 773.88 | 626.56 | 536.3 | 307.57 | 133.59 | 0 | 0 | 0 | 0 | 339.96 | 573.56 | 785.38 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4076.8 (98)

Space heating requirement in kWh/m²/year 67.15 (99)

# TFEE WorkSheet: New dwelling design stage

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10) | | | | | | | | | | | | | |
| (100)m= | 0 | 0 | 0 | 0 | 0 | 904.38 | 711.96 | 729.94 | 0 | 0 | 0 | 0 | (100) |
| Utilisation factor for loss hm | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.81 | 0.87 | 0.82 | 0 | 0 | 0 | 0 | (101) |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 728.88 | 619.47 | 598.02 | 0 | 0 | 0 | 0 | (102) |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 925.61 | 875.83 | 773.17 | 0 | 0 | 0 | 0 | (103) |

*Space cooling requirement for month, whole dwelling, continuous ( kWh) = 0.024 x [(103)m – (102)m ] x (41)m*
set (104)m to zero if (104)m < 3 × (98)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (104)m= | 0 | 0 | 0 | 0 | 0 | 141.65 | 190.73 | 130.31 | 0 | 0 | 0 | 0 |

Total = Sum(104) = 462.7 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (106)m= | 0 | 0 | 0 | 0 | 0 | 0.25 | 0.25 | 0.25 | 0 | 0 | 0 | 0 |

*Total = Sum(104)* = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (107)m= | 0 | 0 | 0 | 0 | 0 | 35.41 | 47.68 | 32.58 | 0 | 0 | 0 | 0 |

Total = Sum(107) = 115.67 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.91 (108)

## 8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 69.06 (109)

**Target Fabric Energy Efficiency (TFEE)** 79.42 (109)

# SAP WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Michael Langley | **Stroma Number:** | STRO036755 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.5.51 |

## Property Address: Flat 16 (Be Lean)

**Address :** Flat 16, 11-12 Market Place, READING, RG1 2EG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 60.71 | (1a) x | 3.5 | (2a) = | 212.48 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 60.71 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 212.48 | (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 | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

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

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 1 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.92 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.14 | (21) |

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

# SAP WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.18 | 0.17 | 0.17 | 0.15 | 0.15 | 0.13 | 0.13 | 0.13 | 0.14 | 0.15 | 0.16 | 0.16 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.29 | 0.29 | 0.28 | 0.27 | 0.26 | 0.25 | 0.25 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | (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 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.29 | 0.29 | 0.28 | 0.27 | 0.26 | 0.25 | 0.25 | 0.24 | 0.25 | 0.26 | 0.27 | 0.28 | (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 | | | 2.04 | x 1/[1/( 1 )+ 0.04] | | = | 1.96 | | | (27) |
| Windows Type 2 | | | 2.47 | x 1/[1/( 1 )+ 0.04] | | = | 2.38 | | | (27) |
| Windows Type 3 | | | 2.37 | x 1/[1/( 1 )+ 0.04] | | = | 2.28 | | | (27) |
| Windows Type 4 | | | 2.04 | x1/[1/( 1.2 )+ 0.04] | | = | 2.34 | | | (27) |
| Windows Type 5 | | | 3.81 | x1/[1/( 1.2 )+ 0.04] | | = | 4.36 | | | (27) |
| Rooflights Type 1 | | | 1.1 | x1/[1/(1.2) + 0.04] | | = | 1.32 | | | (27b) |
| Rooflights Type 2 | | | 0.765 | x1/[1/(1.2) + 0.04] | | = | 0.918 | | | (27b) |
| Walls | 76.51 | 12.73 | 63.78 | x | 0.14 | = | 8.93 | | | (29) |
| Roof | 60.71 | 1.87 | 58.84 | x | 0.13 | = | 7.65 | | | (30) |
| Total area of elements, m² | | | 137.22 | | | | | | | (31) |
| Party wall | | | 55.51 | x | 0 | = | 0 | | | (32) |
| Party floor | | | 60.71 | | | | | | | (32a) |
| Internal wall ** | | | 168.16 | | | | | | | (32c) |

** 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) = 32.03 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 6155.66 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 22.29 (36)

# SAP WorkSheet: New dwelling design stage

*if details of thermal bridging are not known (36) = 0.05 x (31)*

Total fabric heat loss (33) + (36) = 54.32 (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= | 20.35 | 20.1 | 19.86 | 18.64 | 18.4 | 17.18 | 17.18 | 16.94 | 17.67 | 18.4 | 18.89 | 19.37 | (38) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 74.67 | 74.42 | 74.18 | 72.96 | 72.72 | 71.51 | 71.51 | 71.26 | 71.99 | 72.72 | 73.21 | 73.69 |

Average = Sum(39)$_{1...12}$ /12= 72.9 (39)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.23 | 1.23 | 1.22 | 1.2 | 1.2 | 1.18 | 1.18 | 1.17 | 1.19 | 1.2 | 1.21 | 1.21 |

Average = Sum(40)$_{1...12}$ /12= 1.2 (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 (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 81.74 (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= | 89.91 | 86.64 | 83.37 | 80.1 | 76.83 | 73.56 | 73.56 | 76.83 | 80.1 | 83.37 | 86.64 | 89.91 |

Total = Sum(44)$_{1...12}$ = 980.87 (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= | 133.34 | 116.62 | 120.34 | 104.91 | 100.67 | 86.87 | 80.5 | 92.37 | 93.47 | 108.94 | 118.91 | 129.13 |

Total = Sum(45)$_{1...12}$ = 1286.07 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 20 | 17.49 | 18.05 | 15.74 | 15.1 | 13.03 | 12.07 | 13.86 | 14.02 | 16.34 | 17.84 | 19.37 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (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): 1.61 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.87 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.87 (55)

# SAP WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 26.95 | 24.34 | 26.95 | 26.08 | 26.95 | 26.08 | 26.95 | 26.95 | 26.08 | 26.95 | 26.08 | 26.95 | (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= | 26.95 | 24.34 | 26.95 | 26.08 | 26.95 | 26.08 | 26.95 | 26.95 | 26.08 | 26.95 | 26.08 | 26.95 | (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= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (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= | 183.55 | 161.97 | 170.55 | 153.51 | 150.88 | 135.46 | 130.71 | 142.59 | 142.07 | 159.15 | 167.51 | 179.34 | (62) |

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

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

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

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 183.55 | 161.97 | 170.55 | 153.51 | 150.88 | 135.46 | 130.71 | 142.59 | 142.07 | 159.15 | 167.51 | 179.34 |

Output from water heater (annual)$_{1...12}$ | 1877.3 | (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= | 84.51 | 75.06 | 80.18 | 73.76 | 73.64 | 67.76 | 66.94 | 70.88 | 69.96 | 76.39 | 78.41 | 83.11 | (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= | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | 120.1 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 38.94 | 34.59 | 28.13 | 21.3 | 15.92 | 13.44 | 14.52 | 18.88 | 25.34 | 32.17 | 37.55 | 40.03 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 260.8 | 263.5 | 256.68 | 242.17 | 223.84 | 206.61 | 195.11 | 192.4 | 199.22 | 213.74 | 232.07 | 249.29 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | 49.01 | (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= | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 113.58 | 111.7 | 107.77 | 102.44 | 98.98 | 94.11 | 89.97 | 95.27 | 97.16 | 102.68 | 108.91 | 111.7 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 505.37 | 501.83 | 484.63 | 457.95 | 430.78 | 406.21 | 391.64 | 398.6 | 413.76 | 440.63 | 470.56 | 493.06 | (73) |

## 6. Solar gains:

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

# SAP WorkSheet: New dwelling design stage

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 2.04 | x | 11.28 | x | 0.63 | x | 0.8 | = | 8.04 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 11.28 | x | 0.63 | x | 0.8 | = | 9.73 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 11.28 | x | 0.63 | x | 0.8 | = | 9.34 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 11.28 | x | 0.63 | x | 0.8 | = | 8.04 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 11.28 | x | 0.63 | x | 0.8 | = | 15.01 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 22.97 | x | 0.63 | x | 0.8 | = | 16.36 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 22.97 | x | 0.63 | x | 0.8 | = | 19.81 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 22.97 | x | 0.63 | x | 0.8 | = | 19.01 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 22.97 | x | 0.63 | x | 0.8 | = | 16.36 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 22.97 | x | 0.63 | x | 0.8 | = | 30.56 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 41.38 | x | 0.63 | x | 0.8 | = | 29.48 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 41.38 | x | 0.63 | x | 0.8 | = | 35.7 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 41.38 | x | 0.63 | x | 0.8 | = | 34.25 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 41.38 | x | 0.63 | x | 0.8 | = | 29.48 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 41.38 | x | 0.63 | x | 0.8 | = | 55.06 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 67.96 | x | 0.63 | x | 0.8 | = | 48.42 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 67.96 | x | 0.63 | x | 0.8 | = | 58.63 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 67.96 | x | 0.63 | x | 0.8 | = | 56.25 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 67.96 | x | 0.63 | x | 0.8 | = | 48.42 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 67.96 | x | 0.63 | x | 0.8 | = | 90.43 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.35 | x | 0.63 | x | 0.8 | = | 65.09 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 91.35 | x | 0.63 | x | 0.8 | = | 78.8 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 91.35 | x | 0.63 | x | 0.8 | = | 75.61 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.35 | x | 0.63 | x | 0.8 | = | 65.09 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 91.35 | x | 0.63 | x | 0.8 | = | 121.56 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 97.38 | x | 0.63 | x | 0.8 | = | 69.39 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 97.38 | x | 0.63 | x | 0.8 | = | 84.01 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 97.38 | x | 0.63 | x | 0.8 | = | 80.61 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 97.38 | x | 0.63 | x | 0.8 | = | 69.39 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 97.38 | x | 0.63 | x | 0.8 | = | 129.59 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.1 | x | 0.63 | x | 0.8 | = | 64.91 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 91.1 | x | 0.63 | x | 0.8 | = | 78.59 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 91.1 | x | 0.63 | x | 0.8 | = | 75.41 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.1 | x | 0.63 | x | 0.8 | = | 64.91 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 91.1 | x | 0.63 | x | 0.8 | = | 121.23 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 72.63 | x | 0.63 | x | 0.8 | = | 51.75 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 72.63 | x | 0.63 | x | 0.8 | = | 62.66 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 72.63 | x | 0.63 | x | 0.8 | = | 60.12 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 72.63 | x | 0.63 | x | 0.8 | = | 51.75 | (81) |

# SAP WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 3.81 | x | 72.63 | x | 0.63 | x | 0.8 | = | 96.65 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 50.42 | x | 0.63 | x | 0.8 | = | 35.93 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 50.42 | x | 0.63 | x | 0.8 | = | 43.5 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 50.42 | x | 0.63 | x | 0.8 | = | 41.74 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 50.42 | x | 0.63 | x | 0.8 | = | 35.93 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 50.42 | x | 0.63 | x | 0.8 | = | 67.1 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 28.07 | x | 0.63 | x | 0.8 | = | 20 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 28.07 | x | 0.63 | x | 0.8 | = | 24.21 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 28.07 | x | 0.63 | x | 0.8 | = | 23.23 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 28.07 | x | 0.63 | x | 0.8 | = | 20 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 28.07 | x | 0.63 | x | 0.8 | = | 37.35 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 14.2 | x | 0.63 | x | 0.8 | = | 10.12 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 14.2 | x | 0.63 | x | 0.8 | = | 12.25 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 14.2 | x | 0.63 | x | 0.8 | = | 11.75 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 14.2 | x | 0.63 | x | 0.8 | = | 10.12 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 14.2 | x | 0.63 | x | 0.8 | = | 18.89 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 9.21 | x | 0.63 | x | 0.8 | = | 6.57 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 9.21 | x | 0.63 | x | 0.8 | = | 7.95 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 9.21 | x | 0.63 | x | 0.8 | = | 7.63 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 9.21 | x | 0.63 | x | 0.8 | = | 6.57 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 9.21 | x | 0.63 | x | 0.8 | = | 12.26 | (81) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 26 | x | 0.63 | x | 0.8 | = | 12.97 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 26 | x | 0.63 | x | 0.8 | = | 9.02 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 54 | x | 0.63 | x | 0.8 | = | 26.94 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 54 | x | 0.63 | x | 0.8 | = | 18.74 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 96 | x | 0.63 | x | 0.8 | = | 47.9 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 96 | x | 0.63 | x | 0.8 | = | 33.31 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 150 | x | 0.63 | x | 0.8 | = | 74.84 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 150 | x | 0.63 | x | 0.8 | = | 52.05 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 192 | x | 0.63 | x | 0.8 | = | 95.8 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 192 | x | 0.63 | x | 0.8 | = | 66.62 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 200 | x | 0.63 | x | 0.8 | = | 99.79 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 200 | x | 0.63 | x | 0.8 | = | 69.4 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 189 | x | 0.63 | x | 0.8 | = | 94.3 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 189 | x | 0.63 | x | 0.8 | = | 65.58 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 157 | x | 0.63 | x | 0.8 | = | 78.34 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 157 | x | 0.63 | x | 0.8 | = | 54.48 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 115 | x | 0.63 | x | 0.8 | = | 57.38 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 115 | x | 0.63 | x | 0.8 | = | 39.91 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 66 | x | 0.63 | x | 0.8 | = | 32.93 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 66 | x | 0.63 | x | 0.8 | = | 22.9 | (82) |

# SAP WorkSheet: New dwelling design stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rooflights 0.9x | 1 | x | 1.1 | x | 33 | x | 0.63 | x | 0.8 | = | 16.47 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 33 | x | 0.63 | x | 0.8 | = | 11.45 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 21 | x | 0.63 | x | 0.8 | = | 10.48 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 21 | x | 0.63 | x | 0.8 | = | 7.29 | (82) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 72.16 | 147.8 | 265.19 | 429.04 | 568.57 | 602.19 | 564.94 | 455.73 | 321.47 | 180.63 | 91.04 | 58.73 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 577.53 | 649.63 | 749.82 | 886.99 | 999.36 | 1008.39 | 956.59 | 854.33 | 735.23 | 621.26 | 561.6 | 551.8 | (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= | 0.92 | 0.89 | 0.83 | 0.72 | 0.57 | 0.42 | 0.32 | 0.36 | 0.57 | 0.78 | 0.89 | 0.92 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 18.94 | 19.22 | 19.7 | 20.28 | 20.69 | 20.9 | 20.96 | 20.95 | 20.77 | 20.22 | 19.5 | 18.9 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.9 | 19.9 | 19.9 | 19.92 | 19.92 | 19.94 | 19.94 | 19.94 | 19.93 | 19.92 | 19.92 | 19.91 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.9 | 0.87 | 0.81 | 0.68 | 0.52 | 0.36 | 0.24 | 0.29 | 0.5 | 0.75 | 0.87 | 0.91 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.2 | 17.59 | 18.27 | 19.07 | 19.59 | 19.85 | 19.92 | 19.91 | 19.72 | 19.02 | 18.01 | 17.15 | (90) |

fLA = Living area ÷ (4) = 0.31 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.74 | 18.1 | 18.71 | 19.45 | 19.93 | 20.17 | 20.24 | 20.23 | 20.04 | 19.39 | 18.47 | 17.69 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.74 | 18.1 | 18.71 | 19.45 | 19.93 | 20.17 | 20.24 | 20.23 | 20.04 | 19.39 | 18.47 | 17.69 | (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= | 0.88 | 0.84 | 0.78 | 0.67 | 0.52 | 0.37 | 0.27 | 0.31 | 0.51 | 0.73 | 0.84 | 0.88 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 505.8 | 547.87 | 584.46 | 589.85 | 520.85 | 375.66 | 253.53 | 262.9 | 375.64 | 452.38 | 471.97 | 488.34 | (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= | 1003.62 | 982.13 | 905.76 | 769.58 | 598.57 | 398.64 | 260.25 | 272.86 | 427.98 | 639.25 | 832.53 | 994.31 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 370.38 | 291.82 | 239.05 | 129.4 | 57.82 | 0 | 0 | 0 | 0 | 139.03 | 259.6 | 376.44 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1863.56 (98)

Space heating requirement in kWh/m²/year 30.7 (99)

# SAP WorkSheet: New dwelling design stage

## 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) | 370.38 | 291.82 | 239.05 | 129.4 | 57.82 | 0 | 0 | 0 | 0 | 139.03 | 259.6 | 376.44 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 409.72 | 322.81 | 264.43 | 143.14 | 63.96 | 0 | 0 | 0 | 0 | 153.8 | 287.17 | 416.42 | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | | | | | | | | | | | | | 2061.45 (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) | 183.55 | 161.97 | 170.55 | 153.51 | 150.88 | 135.46 | 130.71 | 142.59 | 142.07 | 159.15 | 167.51 | 179.34 | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 (216) |
| (217)m= | 86.78 | 86.52 | 85.9 | 84.62 | 82.87 | 80.3 | 80.3 | 80.3 | 80.3 | 84.71 | 86.15 | 86.87 | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | |
| (219)m= | 211.51 | 187.22 | 198.55 | 181.4 | 182.08 | 168.7 | 162.78 | 177.57 | 176.92 | 187.87 | 194.43 | 206.44 | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2235.46 (219) |

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 2061.45 | |
| Water heating fuel used | | 2235.46 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| mechanical ventilation - balanced, extract or positive input from outside | 162.02 | | (230a) |
| central heating pump: | 30 | | (230c) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | 192.02 | (231) |
| Electricity for lighting | | 275.11 | (232) |
| Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = | | 4764.04 | (338) |

## 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 = | 71.74 | (240) |
| Space heating - main system 2 | (213) x | 0 | x 0.01 = | 0 | (241) |
| Space heating - secondary | (215) x | 13.19 | x 0.01 = | 0 | (242) |

# SAP WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Water heating cost (other fuel) | (219) | 3.48 | x 0.01 = | 77.79 | (247) |
| Pumps, fans and electric keep-hot | (231) | 13.19 | x 0.01 = | 25.33 | (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 = | 36.29 | (250) |
| Additional standing charges (Table 12) | | | | 120 | (251) |

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

| | | | |
|---|---|---|---|
| **Total energy cost** | (245)...(247) + (250)…(254) = | 331.15 | (255) |

## 11a. SAP rating - individual heating systems

| | | | |
|---|---|---|---|
| Energy cost deflator (Table 12) | | 0.42 | (256) |
| Energy cost factor (ECF) | [(255) x (256)] ÷ [(4) + 45.0] = | 1.32 | (257) |
| **SAP rating (Section 12)** | | 81.65 | (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 | = | 445.27 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 482.86 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 928.13 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 99.66 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 142.78 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1170.57 | (272) |
| **CO2 emissions per m²** | | (272) ÷ (4) = | | 19.28 | (273) |
| EI rating (section 14) | | | | 85 | (274) |

## 13a. Primary Energy

| | **Energy** kWh/year | **Primary** factor | | **P. Energy** kWh/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 1.22 | = | 2514.97 | (261) |
| Space heating (secondary) | (215) x | 3.07 | = | 0 | (263) |
| Energy for water heating | (219) x | 1.22 | = | 2727.26 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 5242.24 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 3.07 | = | 589.5 | (267) |
| Electricity for lighting | (232) x | 0 | = | 844.58 | (268) |
| 'Total Primary Energy | | sum of (265)…(271) = | | 6676.31 | (272) |
| **Primary energy kWh/m²/year** | | (272) ÷ (4) = | | 109.97 | (273) |

# TER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Michael Langley | **Stroma Number:** | STRO036755 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.5.51 |

## Property Address: Flat 16 (Be Lean)

**Address :** Flat 16, 11-12 Market Place, READING, RG1 2EG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 60.71 | (1a) x | 3.5 | (2a) = | 212.48 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 60.71 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 212.48 | (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) = | 0.09 | (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) | 0.34 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 1 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.92 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.32 | (21) |

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

# TER WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.41 | 0.4 | 0.39 | 0.35 | 0.34 | 0.3 | 0.3 | 0.29 | 0.32 | 0.34 | 0.36 | 0.37 |

*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= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (24d) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (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 | | | 2.04 | x1/[1/( 1.4 )+ 0.04] | | = | 2.7 | | | (27) |
| Windows Type 2 | | | 2.47 | x1/[1/( 1.4 )+ 0.04] | | = | 3.27 | | | (27) |
| Windows Type 3 | | | 2.37 | x1/[1/( 1.4 )+ 0.04] | | = | 3.14 | | | (27) |
| Windows Type 4 | | | 2.04 | x1/[1/( 1.4 )+ 0.04] | | = | 2.7 | | | (27) |
| Windows Type 5 | | | 3.81 | x1/[1/( 1.4 )+ 0.04] | | = | 5.05 | | | (27) |
| Rooflights Type 1 | | | 1.1 | x1/[1/(1.7) + 0.04] | | = | 1.87 | | | (27b) |
| Rooflights Type 2 | | | 0.765 | x1/[1/(1.7) + 0.04] | | = | 1.3005 | | | (27b) |
| Walls | 76.51 | 12.73 | 63.78 | x | 0.18 | = | 11.48 | | | (29) |
| Roof | 60.71 | 1.87 | 58.84 | x | 0.13 | = | 7.65 | | | (30) |
| Total area of elements, m² | | | 137.22 | | | | | | | (31) |
| Party wall | | | 55.51 | x | 0 | = | 0 | | | (32) |
| Party floor | | | 60.71 | | | | | | | (32a) |
| Internal wall ** | | | 168.16 | | | | | | | (32c) |

** 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) = 38.98 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 6155.66 (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 18.97 (36)

# TER WorkSheet: New dwelling design stage

*if details of thermal bridging are not known (36) = 0.05 x (31)*

Total fabric heat loss (33) + (36) = 57.94 (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= | 40.83 | 40.61 | 40.39 | 39.36 | 39.17 | 38.27 | 38.27 | 38.1 | 38.61 | 39.17 | 39.56 | 39.96 | (38) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 98.78 | 98.56 | 98.34 | 97.3 | 97.11 | 96.21 | 96.21 | 96.04 | 96.56 | 97.11 | 97.5 | 97.91 |

Average = Sum(39)$_{1...12}$ /12= 97.3 (39)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.63 | 1.62 | 1.62 | 1.6 | 1.6 | 1.58 | 1.58 | 1.58 | 1.59 | 1.6 | 1.61 | 1.61 |

Average = Sum(40)$_{1...12}$ /12= 1.6 (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 (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 81.74 (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= | 89.91 | 86.64 | 83.37 | 80.1 | 76.83 | 73.56 | 73.56 | 76.83 | 80.1 | 83.37 | 86.64 | 89.91 |

Total = Sum(44)$_{1...12}$ = 980.87 (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= | 133.34 | 116.62 | 120.34 | 104.91 | 100.67 | 86.87 | 80.5 | 92.37 | 93.47 | 108.94 | 118.91 | 129.13 |

Total = Sum(45)$_{1...12}$ = 1286.07 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 20 | 17.49 | 18.05 | 15.74 | 15.1 | 13.03 | 12.07 | 13.86 | 14.02 | 16.34 | 17.84 | 19.37 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.89 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.02 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.02 (55)

# TER WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 31.64 | 28.58 | 31.64 | 30.62 | 31.64 | 30.62 | 31.64 | 31.64 | 30.62 | 31.64 | 30.62 | 31.64 | (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= | 31.64 | 28.58 | 31.64 | 30.62 | 31.64 | 30.62 | 31.64 | 31.64 | 30.62 | 31.64 | 30.62 | 31.64 | (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= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (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= | 188.24 | 166.21 | 175.25 | 158.05 | 155.58 | 140 | 135.4 | 147.28 | 146.61 | 163.84 | 172.05 | 184.04 | (62) |

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

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

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

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 188.24 | 166.21 | 175.25 | 158.05 | 155.58 | 140 | 135.4 | 147.28 | 146.61 | 163.84 | 172.05 | 184.04 |

Output from water heater (annual)$_{1...12}$ | 1932.55 | (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= | 88.26 | 78.45 | 83.94 | 77.39 | 77.4 | 71.39 | 70.69 | 74.64 | 73.59 | 80.15 | 82.05 | 86.86 | (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= | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | 100.08 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 15.58 | 13.84 | 11.25 | 8.52 | 6.37 | 5.38 | 5.81 | 7.55 | 10.13 | 12.87 | 15.02 | 16.01 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 174.73 | 176.55 | 171.98 | 162.25 | 149.97 | 138.43 | 130.72 | 128.91 | 133.48 | 143.2 | 155.48 | 167.02 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | 33.01 | (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= | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | -80.07 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 118.63 | 116.74 | 112.82 | 107.49 | 104.03 | 99.16 | 95.01 | 100.32 | 102.21 | 107.72 | 113.95 | 116.75 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 364.97 | 363.15 | 352.08 | 334.28 | 316.39 | 298.99 | 287.57 | 292.8 | 301.84 | 319.82 | 340.48 | 355.81 | (73) |

## 6. Solar gains:

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

# TER WorkSheet: New dwelling design stage

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 2.04 | x | 11.28 | x | 0.63 | x | 0.7 | = | 7.03 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 11.28 | x | 0.63 | x | 0.7 | = | 8.52 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 11.28 | x | 0.63 | x | 0.7 | = | 8.17 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 11.28 | x | 0.63 | x | 0.7 | = | 7.03 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 11.28 | x | 0.63 | x | 0.7 | = | 13.14 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 22.97 | x | 0.63 | x | 0.7 | = | 14.32 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 22.97 | x | 0.63 | x | 0.7 | = | 17.34 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 22.97 | x | 0.63 | x | 0.7 | = | 16.63 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 22.97 | x | 0.63 | x | 0.7 | = | 14.32 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 22.97 | x | 0.63 | x | 0.7 | = | 26.74 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 41.38 | x | 0.63 | x | 0.7 | = | 25.8 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 41.38 | x | 0.63 | x | 0.7 | = | 31.24 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 41.38 | x | 0.63 | x | 0.7 | = | 29.97 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 41.38 | x | 0.63 | x | 0.7 | = | 25.8 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 41.38 | x | 0.63 | x | 0.7 | = | 48.18 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 67.96 | x | 0.63 | x | 0.7 | = | 42.37 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 67.96 | x | 0.63 | x | 0.7 | = | 51.3 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 67.96 | x | 0.63 | x | 0.7 | = | 49.22 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 67.96 | x | 0.63 | x | 0.7 | = | 42.37 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 67.96 | x | 0.63 | x | 0.7 | = | 79.13 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.35 | x | 0.63 | x | 0.7 | = | 56.95 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 91.35 | x | 0.63 | x | 0.7 | = | 68.95 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 91.35 | x | 0.63 | x | 0.7 | = | 66.16 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.35 | x | 0.63 | x | 0.7 | = | 56.95 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 91.35 | x | 0.63 | x | 0.7 | = | 106.36 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 97.38 | x | 0.63 | x | 0.7 | = | 60.71 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 97.38 | x | 0.63 | x | 0.7 | = | 73.51 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 97.38 | x | 0.63 | x | 0.7 | = | 70.54 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 97.38 | x | 0.63 | x | 0.7 | = | 60.71 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 97.38 | x | 0.63 | x | 0.7 | = | 113.39 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.1 | x | 0.63 | x | 0.7 | = | 56.8 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 91.1 | x | 0.63 | x | 0.7 | = | 68.77 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 91.1 | x | 0.63 | x | 0.7 | = | 65.98 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 91.1 | x | 0.63 | x | 0.7 | = | 56.8 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 91.1 | x | 0.63 | x | 0.7 | = | 106.08 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 72.63 | x | 0.63 | x | 0.7 | = | 45.28 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 72.63 | x | 0.63 | x | 0.7 | = | 54.82 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 72.63 | x | 0.63 | x | 0.7 | = | 52.6 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 72.63 | x | 0.63 | x | 0.7 | = | 45.28 | (81) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 3.81 | x | 72.63 | x | 0.63 | x | 0.7 | = | 84.57 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 50.42 | x | 0.63 | x | 0.7 | = | 31.43 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 50.42 | x | 0.63 | x | 0.7 | = | 38.06 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 50.42 | x | 0.63 | x | 0.7 | = | 36.52 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 50.42 | x | 0.63 | x | 0.7 | = | 31.43 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 50.42 | x | 0.63 | x | 0.7 | = | 58.71 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 28.07 | x | 0.63 | x | 0.7 | = | 17.5 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 28.07 | x | 0.63 | x | 0.7 | = | 21.19 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 28.07 | x | 0.63 | x | 0.7 | = | 20.33 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 28.07 | x | 0.63 | x | 0.7 | = | 17.5 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 28.07 | x | 0.63 | x | 0.7 | = | 32.68 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 14.2 | x | 0.63 | x | 0.7 | = | 8.85 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 14.2 | x | 0.63 | x | 0.7 | = | 10.72 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 14.2 | x | 0.63 | x | 0.7 | = | 10.28 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 14.2 | x | 0.63 | x | 0.7 | = | 8.85 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 14.2 | x | 0.63 | x | 0.7 | = | 16.53 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 9.21 | x | 0.63 | x | 0.7 | = | 5.74 | (81) |
| Northwest 0.9x | 0.77 | x | 2.47 | x | 9.21 | x | 0.63 | x | 0.7 | = | 6.96 | (81) |
| Northwest 0.9x | 0.77 | x | 2.37 | x | 9.21 | x | 0.63 | x | 0.7 | = | 6.67 | (81) |
| Northwest 0.9x | 0.77 | x | 2.04 | x | 9.21 | x | 0.63 | x | 0.7 | = | 5.74 | (81) |
| Northwest 0.9x | 0.77 | x | 3.81 | x | 9.21 | x | 0.63 | x | 0.7 | = | 10.73 | (81) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 26 | x | 0.63 | x | 0.7 | = | 11.35 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 26 | x | 0.63 | x | 0.7 | = | 7.89 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 54 | x | 0.63 | x | 0.7 | = | 23.58 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 54 | x | 0.63 | x | 0.7 | = | 16.4 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 96 | x | 0.63 | x | 0.7 | = | 41.91 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 96 | x | 0.63 | x | 0.7 | = | 29.15 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 150 | x | 0.63 | x | 0.7 | = | 65.49 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 150 | x | 0.63 | x | 0.7 | = | 45.54 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 192 | x | 0.63 | x | 0.7 | = | 83.83 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 192 | x | 0.63 | x | 0.7 | = | 58.3 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 200 | x | 0.63 | x | 0.7 | = | 87.32 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 200 | x | 0.63 | x | 0.7 | = | 60.73 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 189 | x | 0.63 | x | 0.7 | = | 82.52 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 189 | x | 0.63 | x | 0.7 | = | 57.39 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 157 | x | 0.63 | x | 0.7 | = | 68.54 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 157 | x | 0.63 | x | 0.7 | = | 47.67 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 115 | x | 0.63 | x | 0.7 | = | 50.21 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 115 | x | 0.63 | x | 0.7 | = | 34.92 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 66 | x | 0.63 | x | 0.7 | = | 28.81 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 66 | x | 0.63 | x | 0.7 | = | 20.04 | (82) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rooflights 0.9x | 1 | x | 1.1 | x | 33 | x | 0.63 | x | 0.7 | = | 14.41 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 33 | x | 0.63 | x | 0.7 | = | 10.02 | (82) |
| Rooflights 0.9x | 1 | x | 1.1 | x | 21 | x | 0.63 | x | 0.7 | = | 9.17 | (82) |
| Rooflights 0.9x | 1 | x | 0.76 | x | 21 | x | 0.63 | x | 0.7 | = | 6.38 | (82) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 63.14 | 129.32 | 232.04 | 375.41 | 497.5 | 526.91 | 494.33 | 398.77 | 281.28 | 158.05 | 79.66 | 51.39 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 428.11 | 492.47 | 584.12 | 709.7 | 813.89 | 825.9 | 781.9 | 691.57 | 583.13 | 477.87 | 420.14 | 407.2 | (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 | 0.94 | 0.83 | 0.67 | 0.52 | 0.59 | 0.85 | 0.97 | 0.99 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.26 | 19.44 | 19.78 | 20.27 | 20.68 | 20.91 | 20.97 | 20.96 | 20.75 | 20.22 | 19.66 | 19.23 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.59 | 19.6 | 19.6 | 19.61 | 19.61 | 19.62 | 19.62 | 19.63 | 19.62 | 19.61 | 19.61 | 19.6 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.99 | 0.99 | 0.97 | 0.92 | 0.77 | 0.55 | 0.37 | 0.44 | 0.76 | 0.95 | 0.99 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.33 | 17.59 | 18.1 | 18.79 | 19.32 | 19.57 | 19.62 | 19.61 | 19.43 | 18.74 | 17.93 | 17.3 | (90) |

fLA = Living area ÷ (4) = | 0.31 | (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.93 | 18.16 | 18.62 | 19.25 | 19.74 | 19.98 | 20.04 | 20.03 | 19.84 | 19.19 | 18.46 | 17.9 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.93 | 18.16 | 18.62 | 19.25 | 19.74 | 19.98 | 20.04 | 20.03 | 19.84 | 19.19 | 18.46 | 17.9 | (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 | 0.99 | 0.97 | 0.91 | 0.78 | 0.59 | 0.41 | 0.49 | 0.78 | 0.95 | 0.99 | 0.99 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 424.53 | 485.26 | 564.48 | 644.05 | 633.89 | 483.39 | 323.91 | 336.15 | 452.25 | 452.95 | 414.04 | 404.38 | (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= | 1346.03 | 1306.94 | 1191.65 | 1006.77 | 780.79 | 517.81 | 330.53 | 348.26 | 554.11 | 834.54 | 1107.81 | 1340.97 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 685.6 | 552.17 | 466.61 | 261.16 | 109.29 | 0 | 0 | 0 | 0 | 283.9 | 499.51 | 696.82 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 3555.07 | (98)

Space heating requirement in kWh/m²/year | 58.56 | (99)

# TER WorkSheet: New dwelling design stage

## 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 | | 93.5 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 685.6 | 552.17 | 466.61 | 261.16 | 109.29 | 0 | 0 | 0 | 0 | 283.9 | 499.51 | 696.82 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 733.26 | 590.56 | 499.05 | 279.31 | 116.89 | 0 | 0 | 0 | 0 | 303.64 | 534.24 | 745.27 | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | | | | | | | | | | | | | 3802.21 (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) | 188.24 | 166.21 | 175.25 | 158.05 | 155.58 | 140 | 135.4 | 147.28 | 146.61 | 163.84 | 172.05 | 184.04 | |
| Efficiency of water heater | | | | | | | | | | | | | 79.8 (216) |
| (217)m= | 87.96 | 87.78 | 87.3 | 86.15 | 83.89 | 79.8 | 79.8 | 79.8 | 79.8 | 86.27 | 87.49 | 88.03 | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m= | 214.01 | 189.36 | 200.73 | 183.47 | 185.45 | 175.44 | 169.68 | 184.56 | 183.72 | 189.92 | 196.64 | 209.05 | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2282.04 (219) |

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 3802.21 | |
| Water heating fuel used | | 2282.04 | |
| 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 | | 275.11 | (232) |
| Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = | | 6434.36 | (338) |

## 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 | = | 821.28 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 492.92 | (264) |

# TER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1314.2 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 142.78 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1495.9 | (272) |

**TER =** 24.64 (273)

# Thermal Bridge Report

## Property Details: Flat 16 (Be Lean)

| | |
|---|---|
| Address: | Flat 16, 11-12 Market Place, READING, RG1 2EG |
| Located in: | England |
| Region: | Thames valley |

## Thermal bridges:

Thermal bridges:

User-defined = UD
Default = D
Approved = A
User-defined (individual PSI-values) Y-Value = 0.1625

## External Junctions Details:

| Junction Type | PSI-Value | Length | Reference | Type |
|---|---|---|---|---|
| Other lintels (including other steel lintels) | 0.3 | 5.92 | E2 | [A] |
| Sill | 0.04 | 5.92 | E3 | [A] |
| Jamb | 0.05 | 21.5 | E4 | [A] |
| Party floor between dwellings (in blocks of flats) | 0.07 | 21.86 | E7 | [A] |
| Flat roof with parapet | 0.56 | 21.86 | E15 | [D] |
| Corner (normal) | 0.09 | 7 | E16 | [A] |
| Party wall between dwellings | 0.06 | 7 | E18 | [A] |

## Party Junctions Details:

| | | | | |
|---|---|---|---|---|
| Intermediate floor between dwellings (in blocks of flats) | 0 | 15.86 | P3 | [D] |
| Roof (insulation at ceiling level) | 0.24 | 15.86 | P4 | [D] |

## Roof Junctions Details:

| | | | | |
|---|---|---|---|---|
| Head | 0.08 | 1.95 | R1 | [D] |
| Sill | 0.06 | 1.95 | R2 | [D] |
| Jamb | 0.08 | 3.8 | R3 | [D] |