# Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.9
*Printed on 28 October 2020 at 14:55:16*

## Project Information:

**Assessed By:** Zahid Ashraf (STRO001082) **Building Type:** Flat

## Dwelling Details:

**NEW DWELLING DESIGN STAGE** Total Floor Area: 77.21m²

**Site Reference :** Hermitage Lane **Plot Reference:** Plot 6

**Address :**

## 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 (c) | | |
| Fuel factor: 1.00 (mains gas (c)) | | |
| Target Carbon Dioxide Emission Rate (TER) | 19.65 kg/m² | |
| Dwelling Carbon Dioxide Emission Rate (DER) | 12.62 kg/m² | OK |

## 1b TFEE and DFEE

| | | |
|---|---|---|
| Target Fabric Energy Efficiency (TFEE) | 59.5 kWh/m² | |
| Dwelling Fabric Energy Efficiency (DFEE) | 46.8 kWh/m² | |
| | | OK |

## 2 Fabric U-values

| Element | Average | Highest | |
|---|---|---|---|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Floor | 0.12 (max. 0.25) | 0.12 (max. 0.70) | OK |
| Roof | (no roof) | | |
| Openings | 1.40 (max. 2.00) | 1.40 (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: | Community heating schemes - mains gas |
| Secondary heating system: | None |

## 5 Cylinder insulation

| | |
|---|---|
| Hot water Storage: | No cylinder |

## 6 Controls

| | | |
|---|---|---|
| Space heating controls | Charging system linked to use of community heating, programmer and at least two room thermostats | OK |
| Hot water controls: | No cylinder thermostat<br>No cylinder | |

# Regulations Compliance Report

| 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: | 0.91 | |
| Maximum | 1.5 | **OK** |
| MVHR efficiency: | 93% | |
| Minimum | 70% | **OK** |

| 9 Summertime temperature | | |
|---|---|---|
| Overheating risk (Thames valley): | Slight | **OK** |
| Based on: | | |
| Overshading: | Average or unknown | |
| Windows facing: South West | 3.11m² | |
| Windows facing: South East | 6.1m² | |
| Windows facing: North West | 4.58m² | |
| Ventilation rate: | 6.00 | |

| 10 Key features | |
|---|---|
| Air permeablility | 3.0 m³/m²h |
| Floors U-value | 0.12 W/m²K |
| Community heating, heat from boilers – mains gas | |
| Photovoltaic array | |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Zahid Ashraf | **Stroma Number:** | STRO001082 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.5.9 |

## Property Address: Plot 6

**Address :**

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 77.21 | (1a) x | 2.5 | (2a) = | 193.02 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 77.21 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 193.02 | (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

Monthly average wind speed from Table 7

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (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) = 79.05 (23c)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.28 | 0.28 | 0.27 | 0.26 | 0.25 | 0.24 | 0.24 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | (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= | 0.28 | 0.28 | 0.27 | 0.26 | 0.25 | 0.24 | 0.24 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2 | x | 1.4 | = | 2.8 | | | (26) |
| Windows Type 1 | | | 3.105 | x1/[1/( 1.4 )+ 0.04] | | = | 4.12 | | | (27) |
| Windows Type 2 | | | 6.097 | x1/[1/( 1.4 )+ 0.04] | | = | 8.08 | | | (27) |
| Windows Type 3 | | | 4.579 | x1/[1/( 1.4 )+ 0.04] | | = | 6.07 | | | (27) |
| Floor | | | 77.21 | x | 0.12 | = | 9.2652 | | | (28) |
| Walls Type1 | 78.24 | 13.78 | 64.46 | x | 0.15 | = | 9.67 | | | (29) |
| Walls Type2 | 33.81 | 2 | 31.81 | x | 0.14 | = | 4.48 | | | (29) |
| Total area of elements, m² | | | 189.26 | | | | | | | (31) |

** 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) = 44.49 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 9840.85 (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 14.5 (36)

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

Total fabric heat loss (33) + (36) = 58.99 (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= | 17.94 | 17.72 | 17.5 | 16.39 | 16.17 | 15.07 | 15.07 | 14.85 | 15.51 | 16.17 | 16.62 | 17.06 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 76.93 | 76.71 | 76.49 | 75.39 | 75.16 | 74.06 | 74.06 | 73.84 | 74.5 | 75.16 | 75.61 | 76.05 | |

Average = Sum(39)$_{1…12}$ /12= 75.33 (39)

# DER WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1 | 0.99 | 0.99 | 0.98 | 0.97 | 0.96 | 0.96 | 0.96 | 0.96 | 0.97 | 0.98 | 0.98 |

Average = Sum(40)$_{1…12}$ /12= 0.98 (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    2.41 (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    96.19 (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= | 105.81 | 101.97 | 98.12 | 94.27 | 90.42 | 86.58 | 86.58 | 90.42 | 94.27 | 98.12 | 101.97 | 105.81 |

Total = Sum(44)$_{1…12}$ = 1154.34 (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= | 156.92 | 137.24 | 141.62 | 123.47 | 118.47 | 102.23 | 94.73 | 108.71 | 110.01 | 128.2 | 139.94 | 151.97 |

Total = Sum(45)$_{1…12}$ = 1513.52 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.54 | 20.59 | 21.24 | 18.52 | 17.77 | 15.33 | 14.21 | 16.31 | 16.5 | 19.23 | 20.99 | 22.8 | (46) |

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b    0 (49)

Energy lost from water storage, kWh/year    (48) x (49) =    110 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day)    0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a    1.03 (52)

Temperature factor from Table 2b    0.6 (53)

Energy lost from water storage, kWh/year    (47) x (51) x (52) x (53) =    1.03 (54)

Enter (50) or (54) in (55)    1.03 (55)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (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= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (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= | 212.2 | 187.17 | 196.9 | 176.96 | 173.75 | 155.73 | 150.01 | 163.98 | 163.5 | 183.48 | 193.44 | 207.24 | (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= | 212.2 | 187.17 | 196.9 | 176.96 | 173.75 | 155.73 | 150.01 | 163.98 | 163.5 | 183.48 | 193.44 | 207.24 | |

Output from water heater (annual)$_{1...12}$ 2164.36 (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= | 96.4 | 85.58 | 91.31 | 83.85 | 83.61 | 76.79 | 75.72 | 80.37 | 79.37 | 86.85 | 89.33 | 94.75 | (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= | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| (67)m= | 19.47 | 17.29 | 14.06 | 10.65 | 7.96 | 6.72 | 7.26 | 9.44 | 12.67 | 16.08 | 18.77 | 20.01 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| (68)m= | 213.51 | 215.73 | 210.14 | 198.26 | 183.25 | 169.15 | 159.73 | 157.52 | 163.1 | 174.98 | 189.99 | 204.09 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| (69)m= | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | (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= | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| (72)m= | 129.57 | 127.34 | 122.73 | 116.46 | 112.38 | 106.65 | 101.77 | 108.02 | 110.24 | 116.73 | 124.06 | 127.35 | (72) |
| **Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | | | | | | | |
| (73)m= | 421.66 | 419.48 | 406.05 | 384.48 | 362.71 | 341.64 | 327.88 | 334.09 | 345.12 | 366.91 | 391.94 | 410.57 | (73) |

## 6. Solar gains:

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

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 6.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 68.56 | (77) |
| Southeast 0.9x | 0.77 | x | 6.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 116.78 | (77) |
| Southeast 0.9x | 0.77 | x | 6.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 159.78 | (77) |
| Southeast 0.9x | 0.77 | x | 6.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 197.98 | (77) |
| Southeast 0.9x | 0.77 | x | 6.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 221.76 | (77) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 220.15 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 212.25 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 194.51 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 173.01 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 129.07 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 82.12 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 58.67 | (77) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 36.79 | | 0.63 | x | 0.7 | = | 34.91 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 62.67 | | 0.63 | x | 0.7 | = | 59.47 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 85.75 | | 0.63 | x | 0.7 | = | 81.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 106.25 | | 0.63 | x | 0.7 | = | 100.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 119.01 | | 0.63 | x | 0.7 | = | 112.93 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 118.15 | | 0.63 | x | 0.7 | = | 112.12 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 113.91 | | 0.63 | x | 0.7 | = | 108.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 104.39 | | 0.63 | x | 0.7 | = | 99.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 92.85 | | 0.63 | x | 0.7 | = | 88.11 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 69.27 | | 0.63 | x | 0.7 | = | 65.73 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 44.07 | | 0.63 | x | 0.7 | = | 41.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 31.49 | | 0.63 | x | 0.7 | = | 29.88 | (79) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 11.28 | x | 0.63 | x | 0.7 | = | 15.79 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 22.97 | x | 0.63 | x | 0.7 | = | 32.14 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 41.38 | x | 0.63 | x | 0.7 | = | 57.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 67.96 | x | 0.63 | x | 0.7 | = | 95.1 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 91.35 | x | 0.63 | x | 0.7 | = | 127.83 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 97.38 | x | 0.63 | x | 0.7 | = | 136.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 91.1 | x | 0.63 | x | 0.7 | = | 127.49 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 72.63 | x | 0.63 | x | 0.7 | = | 101.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 50.42 | x | 0.63 | x | 0.7 | = | 70.56 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 28.07 | x | 0.63 | x | 0.7 | = | 39.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 14.2 | x | 0.63 | x | 0.7 | = | 19.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 9.21 | x | 0.63 | x | 0.7 | = | 12.89 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 119.26 | 208.39 | 299.06 | 393.9 | 462.52 | 468.55 | 447.83 | 395.21 | 331.68 | 234.08 | 143.8 | 101.45 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 540.92 | 627.87 | 705.12 | 778.38 | 825.23 | 810.18 | 775.71 | 729.29 | 676.8 | 600.99 | 535.74 | 512.02 | (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 | 0.92 | 0.88 | 0.8 | 0.68 | 0.53 | 0.4 | 0.44 | 0.64 | 0.83 | 0.92 | 0.96 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.12 | 19.4 | 19.8 | 20.29 | 20.66 | 20.88 | 20.96 | 20.95 | 20.79 | 20.31 | 19.63 | 19.07 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.09 | 20.09 | 20.09 | 20.1 | 20.11 | 20.12 | 20.12 | 20.12 | 20.11 | 20.11 | 20.1 | 20.1 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.94 | 0.91 | 0.86 | 0.77 | 0.64 | 0.47 | 0.33 | 0.36 | 0.58 | 0.8 | 0.91 | 0.95 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.56 | 17.97 | 18.55 | 19.23 | 19.73 | 20.01 | 20.09 | 20.08 | 19.91 | 19.27 | 18.32 | 17.5 | (90) |

fLA = Living area ÷ (4) = 0.41 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.2 | 18.55 | 19.06 | 19.66 | 20.11 | 20.37 | 20.45 | 20.44 | 20.27 | 19.69 | 18.86 | 18.14 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.2 | 18.55 | 19.06 | 19.66 | 20.11 | 20.37 | 20.45 | 20.44 | 20.27 | 19.69 | 18.86 | 18.14 | (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 | 0.84 | 0.76 | 0.64 | 0.49 | 0.35 | 0.39 | 0.59 | 0.79 | 0.89 | 0.93 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 499.84 | 560.43 | 594.43 | 590.35 | 526.41 | 393.46 | 275.08 | 284.93 | 398.5 | 474.43 | 478.52 | 477.4 | (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= | 1069.04 | 1047.17 | 960.65 | 811.01 | 631.78 | 427.11 | 284.84 | 298.05 | 459.53 | 683.43 | 888.86 | 1059.86 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 423.48 | 327.09 | 272.46 | 158.88 | 78.4 | 0 | 0 | 0 | 0 | 155.49 | 295.44 | 433.35 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2144.6 (98)

Space heating requirement in kWh/m²/year 27.78 (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community boilers | | 1 | (303a) |
| Fraction of total space heat from Community boilers | (302) x (303a) = | 1 | (304a) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 2144.6 | |
| Space heat from Community boilers | (98) x (304a) x (305) x (306) = | 2251.83 | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |

**Water heating**

| | | | |
|---|---|---|---|
| Annual water heating requirement | | 2164.36 | |
| If DHW from community scheme:<br>Water heat from Community boilers | (64) x (303a) x (305) x (306) = | 2272.58 | (310a) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 45.24 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 267.87 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 267.87 | (331) |
| Energy for lighting (calculated in Appendix L) | | 343.8 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -782.18 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. $CO_2$ Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 94 | (367a) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 1039.65 | (367) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 23.48 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = | 1063.13 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.22 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | | 1063.13 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 139.02 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = | 178.43 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | | x 0.01 = | -405.95 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | | 974.64 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | | 12.62 | (384) |
| **EI rating (section 14)** | | | | | 89.31 | (385) |

# SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 28 October 2020

## Property Details: Plot 6

| | |
|---|---|
| **Dwelling type:** | Flat |
| **Located in:** | England |
| **Region:** | Thames valley |
| **Cross ventilation possible:** | Yes |
| **Number of storeys:** | 1 |
| **Front of dwelling faces:** | North East |
| **Overshading:** | Average or unknown |
| **Overhangs:** | None |
| **Thermal mass parameter:** | Indicative Value Low |
| **Night ventilation:** | False |
| **Blinds, curtains, shutters:** | |
| **Ventilation rate during hot weather (ach):** | 6 ( Windows fully open) |

## Overheating Details:

| | | |
|---|---|---|
| **Summer ventilation heat loss coefficient:** | 382.19 | **(P1)** |
| **Transmission heat loss coefficient:** | 59 | |
| **Summer heat loss coefficient:** | 441.18 | **(P2)** |

## Overhangs:

| **Orientation:** | **Ratio:** | **Z_overhangs:** |
|---|---|---|
| South West (SW) | 0 | 1 |
| South East (SE) | 0 | 1 |
| North West (NW) | 0 | 1 |

## Solar shading:

| **Orientation:** | **Z blinds:** | **Solar access:** | **Overhangs:** | **Z summer:** | |
|---|---|---|---|---|---|
| South West (SW) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South East (SE) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (NW) | 1 | 0.9 | 1 | 0.9 | **(P8)** |

## Solar gains:

| **Orientation** | | **Area** | **Flux** | **g_** | **FF** | **Shading** | **Gains** | |
|---|---|---|---|---|---|---|---|---|
| South West (SW) | 0.9 x | 3.11 | 119.92 | 0.63 | 0.7 | 0.9 | 133.01 | |
| South East (SE) | 0.9 x | 6.1 | 119.92 | 0.63 | 0.7 | 0.9 | 261.18 | |
| North West (NW) | 0.9 x | 4.58 | 98.85 | 0.63 | 0.7 | 0.9 | 161.68 | |
| | | | | | | **Total** | 555.87 | **(P3/P4)** |

## Internal gains:

| | **June** | **July** | **August** | |
|---|---|---|---|---|
| Internal gains | 475.92 | 458.34 | 466.72 | |
| Total summer gains | 1064.26 | 1014.21 | 966.72 | **(P5)** |
| Summer gain/loss ratio | 2.41 | 2.3 | 2.19 | **(P6)** |
| Mean summer external temperature (Thames valley) | 16 | 17.9 | 17.8 | |
| Thermal mass temperature increment | 1.3 | 1.3 | 1.3 | |
| Threshold temperature | 19.71 | 21.5 | 21.29 | **(P7)** |
| **Likelihood of high internal temperature** | **Not significant** | **Slight** | **Slight** | |

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

# DFEE WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Zahid Ashraf | **Stroma Number:** | STRO001082 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.5.9 |

## Property Address: Plot 6

**Address :**

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 77.21 | (1a) x | 2.5 | (2a) = | 193.02 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 77.21 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 193.02 | (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 | | | | | | | 3 | x 10 = | 30 | (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) = | 30 | ÷ (5) = | 0.16 | (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) | 0.31 | (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) = | 0.28 | (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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.36 | 0.35 | 0.35 | 0.31 | 0.3 | 0.27 | 0.27 | 0.26 | 0.28 | 0.3 | 0.32 | 0.33 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.56 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.54 | 0.53 | 0.54 | 0.55 | 0.55 | 0.56 | (24d) |

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

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

## 3. Heat losses and heat loss parameter:

| **ELEMENT** | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2 | x | 1.4 | = | 2.8 | | | (26) |
| Windows Type 1 | | | 3.105 | x1/[1/( 1.4 )+ 0.04] | | = | 4.12 | | | (27) |
| Windows Type 2 | | | 6.097 | x1/[1/( 1.4 )+ 0.04] | | = | 8.08 | | | (27) |
| Windows Type 3 | | | 4.579 | x1/[1/( 1.4 )+ 0.04] | | = | 6.07 | | | (27) |
| Floor | | | 77.21 | x | 0.12 | = | 9.2652 | | | (28) |
| Walls Type1 | 78.24 | 13.78 | 64.46 | x | 0.15 | = | 9.67 | | | (29) |
| Walls Type2 | 33.81 | 2 | 31.81 | x | 0.14 | = | 4.48 | | | (29) |
| Total area of elements, m² | | | 189.26 | | | | | | | (31) |

** 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) = 44.49 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 9840.85 (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 14.5 (36)

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

Total fabric heat loss (33) + (36) = 58.99 (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= | 35.98 | 35.82 | 35.66 | 34.92 | 34.79 | 34.14 | 34.14 | 34.02 | 34.39 | 34.79 | 35.07 | 35.36 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 94.97 | 94.81 | 94.66 | 93.92 | 93.78 | 93.13 | 93.13 | 93.02 | 93.38 | 93.78 | 94.06 | 94.35 | |

Average = Sum(39)$_{1…12}$ /12= 93.92 (39)

# DFEE WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.23 | 1.23 | 1.23 | 1.22 | 1.21 | 1.21 | 1.21 | 1.2 | 1.21 | 1.21 | 1.22 | 1.22 |

Average = Sum(40)$_{1...12}$ /12= 1.22 (40)

Number of days in month (Table 1a)

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

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

Assumed occupancy, N 2.41 (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 96.19 (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)*

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 105.81 | 101.97 | 98.12 | 94.27 | 90.42 | 86.58 | 86.58 | 90.42 | 94.27 | 98.12 | 101.97 | 105.81 |

Total = Sum(44)$_{1...12}$ = 1154.34 (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= | 156.92 | 137.24 | 141.62 | 123.47 | 118.47 | 102.23 | 94.73 | 108.71 | 110.01 | 128.2 | 139.94 | 151.97 |

Total = Sum(45)$_{1...12}$ = 1513.52 (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 0 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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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= | 133.38 | 116.66 | 120.38 | 104.95 | 100.7 | 86.9 | 80.52 | 92.4 | 93.51 | 108.97 | 118.95 | 129.17 | (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= | 133.38 | 116.66 | 120.38 | 104.95 | 100.7 | 86.9 | 80.52 | 92.4 | 93.51 | 108.97 | 118.95 | 129.17 | |

Output from water heater (annual)$_{1...12}$ 1286.49 (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= | 33.35 | 29.16 | 30.09 | 26.24 | 25.18 | 21.72 | 20.13 | 23.1 | 23.38 | 27.24 | 29.74 | 32.29 | (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):

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metabolic gains (Table 5), Watts** | | | | | | | | | | | | | |
| (66)m= | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | (66) |
| **Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5** | | | | | | | | | | | | | |
| (67)m= | 19.47 | 17.29 | 14.06 | 10.65 | 7.96 | 6.72 | 7.26 | 9.44 | 12.67 | 16.08 | 18.77 | 20.01 | (67) |
| **Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5** | | | | | | | | | | | | | |
| (68)m= | 213.51 | 215.73 | 210.14 | 198.26 | 183.25 | 169.15 | 159.73 | 157.52 | 163.1 | 174.98 | 189.99 | 204.09 | (68) |
| **Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5** | | | | | | | | | | | | | |
| (69)m= | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | (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= | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | (71) |
| **Water heating gains (Table 5)** | | | | | | | | | | | | | |
| (72)m= | 44.82 | 43.4 | 40.45 | 36.44 | 33.84 | 30.17 | 27.06 | 31.05 | 32.47 | 36.62 | 41.3 | 43.4 | (72) |
| **Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | | | | | | | |
| (73)m= | 336.91 | 335.53 | 323.77 | 304.46 | 284.17 | 265.16 | 253.17 | 257.12 | 267.35 | 286.8 | 309.18 | 326.62 | (73) |

## 6. Solar gains:

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

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 68.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 116.78 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 159.78 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 197.98 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 221.76 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 220.15 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 212.25 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 194.51 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 173.01 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 129.07 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 82.12 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 58.67 | (77) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 36.79 | | 0.63 | x | 0.7 | = | 34.91 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 62.67 | | 0.63 | x | 0.7 | = | 59.47 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 85.75 | | 0.63 | x | 0.7 | = | 81.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 106.25 | | 0.63 | x | 0.7 | = | 100.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 119.01 | | 0.63 | x | 0.7 | = | 112.93 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 118.15 | | 0.63 | x | 0.7 | = | 112.12 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 113.91 | | 0.63 | x | 0.7 | = | 108.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 104.39 | | 0.63 | x | 0.7 | = | 99.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 92.85 | | 0.63 | x | 0.7 | = | 88.11 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 69.27 | | 0.63 | x | 0.7 | = | 65.73 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 44.07 | | 0.63 | x | 0.7 | = | 41.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 31.49 | | 0.63 | x | 0.7 | = | 29.88 | (79) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 11.28 | x | 0.63 | x | 0.7 | = | 15.79 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 22.97 | x | 0.63 | x | 0.7 | = | 32.14 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 41.38 | x | 0.63 | x | 0.7 | = | 57.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 67.96 | x | 0.63 | x | 0.7 | = | 95.1 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 91.35 | x | 0.63 | x | 0.7 | = | 127.83 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 97.38 | x | 0.63 | x | 0.7 | = | 136.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 91.1 | x | 0.63 | x | 0.7 | = | 127.49 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 72.63 | x | 0.63 | x | 0.7 | = | 101.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 50.42 | x | 0.63 | x | 0.7 | = | 70.56 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 28.07 | x | 0.63 | x | 0.7 | = | 39.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 14.2 | x | 0.63 | x | 0.7 | = | 19.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 9.21 | x | 0.63 | x | 0.7 | = | 12.89 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 119.26 | 208.39 | 299.06 | 393.9 | 462.52 | 468.55 | 447.83 | 395.21 | 331.68 | 234.08 | 143.8 | 101.45 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 456.18 | 543.93 | 622.84 | 698.36 | 746.68 | 733.71 | 700.99 | 652.32 | 599.03 | 520.87 | 452.98 | 428.07 | (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 | 0.86 | 0.77 | 0.64 | 0.51 | 0.56 | 0.74 | 0.89 | 0.95 | 0.97 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 18.42 | 18.73 | 19.2 | 19.79 | 20.33 | 20.71 | 20.88 | 20.85 | 20.55 | 19.84 | 19.02 | 18.36 | (87) |

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.96 | 0.94 | 0.91 | 0.84 | 0.73 | 0.57 | 0.41 | 0.45 | 0.68 | 0.87 | 0.95 | 0.97 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.55 | 17.85 | 18.31 | 18.89 | 19.39 | 19.74 | 19.86 | 19.85 | 19.61 | 18.96 | 18.15 | 17.49 | (90) |

fLA = Living area ÷ (4) = 0.41 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.91 | 18.21 | 18.67 | 19.26 | 19.77 | 20.13 | 20.28 | 20.26 | 19.99 | 19.32 | 18.51 | 17.85 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.91 | 18.21 | 18.67 | 19.26 | 19.77 | 20.13 | 20.28 | 20.26 | 19.99 | 19.32 | 18.51 | 17.85 | (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 | 0.89 | 0.82 | 0.72 | 0.58 | 0.44 | 0.49 | 0.69 | 0.85 | 0.93 | 0.96 | (94) |
| **Useful gains, hmGm , W = (94)m x (84)m** | | | | | | | | | | | | | |
| (95)m= | 433.87 | 504.35 | 553.8 | 574.43 | 538.57 | 427.52 | 311.63 | 318.4 | 410.68 | 444.79 | 421.68 | 409.78 | (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= | 1292.21 | 1261.57 | 1152.28 | 972.94 | 757.2 | 515.34 | 342.62 | 358.64 | 549.99 | 817.65 | 1072.75 | 1287.6 | (97) |
| **Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m** | | | | | | | | | | | | | |
| (98)m= | 638.6 | 508.86 | 445.27 | 286.93 | 162.66 | 0 | 0 | 0 | 0 | 277.41 | 468.77 | 653.1 | |

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3441.6 (98)

Space heating requirement in kWh/m²/year 44.57 (99)

## 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 | 875.47 | 689.2 | 706.92 | 0 | 0 | 0 | 0 | (100) |
| **Utilisation factor for loss hm** | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.74 | 0.81 | 0.78 | 0 | 0 | 0 | 0 | (101) |
| **Useful loss, hmLm (Watts) = (100)m x (101)m** | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 651.98 | 556.41 | 551.72 | 0 | 0 | 0 | 0 | (102) |
| **Gains (solar gains calculated for applicable weather region, see Table 10)** | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 947.1 | 907.06 | 851.68 | 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 | 212.48 | 260.88 | 223.16 | 0 | 0 | 0 | 0 | |

Total = $Sum(104)_{6...8}$ = 696.53 (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 = $Sum(104)_{6...8}$* = 0 (106)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (107)m= | 0 | 0 | 0 | 0 | 0 | 53.12 | 65.22 | 55.79 | 0 | 0 | 0 | 0 |

Total = Sum(107) = 174.13 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 2.26 (108)

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

Fabric Energy Efficiency (99) + (108) = 46.83 (109)

# SAP Input

## Property Details: Plot 6

| | |
|---|---|
| Address: | |
| Located in: | England |
| Region: | Thames valley |
| UPRN: | |
| Date of assessment: | 08 July 2020 |
| Date of certificate: | 28 October 2020 |
| 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: | False |
| PCDF Version: | 466 |

## Property description:

| | | |
|---|---|---|
| Dwelling type: | Flat | |
| Detachment: | | |
| Year Completed: | 2020 | |
| Floor Location: | Floor area: | Storey height: |
| Floor 0 | 77.21 m² | 2.5 m |
| Living area: | 31.45 m² (fraction 0.407) | |
| Front of dwelling faces: | North East | |

## Opening types:

| Name: | Source: | Type: | Glazing: | Argon: | Frame: |
|---|---|---|---|---|---|
| NE | Manufacturer | Solid | | | |
| SW | Manufacturer | Windows | double-glazed | Yes | |
| SE | Manufacturer | Windows | double-glazed | Yes | |
| NW | Manufacturer | Windows | double-glazed | Yes | |

| **Name:** | **Gap:** | **Frame Factor:** | **g-value:** | **U-value:** | **Area:** | **No. of Openings:** |
|---|---|---|---|---|---|---|
| NE | mm | 0 | 0 | 1.4 | 2 | 1 |
| SW | 16mm or more | 0.7 | 0.63 | 1.4 | 3.105 | 1 |
| SE | 16mm or more | 0.7 | 0.63 | 1.4 | 6.097 | 1 |
| NW | 16mm or more | 0.7 | 0.63 | 1.4 | 4.579 | 1 |

| Name: | Type-Name: | Location: | Orient: | Width: | Height: |
|---|---|---|---|---|---|
| NE | | Corridor Wall | North East | 0 | 0 |
| SW | | External Wall | South West | 0 | 0 |
| SE | | External Wall | South East | 0 | 0 |
| NW | | External Wall | North West | 0 | 0 |

Overshading: Average or unknown

## Opaque Elements:

| Type: | Gross area: | Openings: | Net area: | U-value: | Ru value: | Curtain wall: | Kappa: |
|---|---|---|---|---|---|---|---|
| External Elements | | | | | | | |
| External Wall | 78.243 | 13.78 | 64.46 | 0.15 | 0 | False | N/A |
| Corridor Wall | 33.806 | 2 | 31.81 | 0.15 | 0.43 | False | N/A |
| Ground Floor | 77.21 | | | 0.12 | | | N/A |
| Internal Elements | | | | | | | |
| Party Elements | | | | | | | |

## Thermal bridges:

# SAP Input

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0766

| | Length | Psi-value | | |
|---|---|---|---|---|
| | 7.495 | 0.294 | E2 | Other lintels (including other steel lintels) |
| | 24.6 | 0.049 | E4 | Jamb |
| | 37.983 | 0.153 | E5 | Ground floor (normal) |
| | 34.031 | 0.067 | E7 | Party floor between dwellings (in blocks of flats) |
| | 11.8 | 0.083 | E16 | Corner (normal) |
| | 3.951 | 0.136 | E21 | Exposed floor (inverted) |
| | 2.95 | -0.072 | E17 | Corner (inverted internal area greater than external area) |
| | 5.9 | 0.108 | E25 | Staggered party wall between dwellings |
| [Approved] | 1.8 | 0.04 | E3 | Sill |
| | 6.193 | 0.16 | P1 | Ground floor |
| | 6.193 | 0 | P3 | Intermediate floor between dwellings (in blocks of flats) |

## Ventilation:

Pressure test: Yes (As designed)

Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 1
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: Community heating schemes
Heat source: Community boilers
heat from boilers – mains gas, heat fraction 1, efficiency 94
Piping>=1991, pre-insulated, low temp, variable flow
Central heating pump : 2013 or later
Design flow temperature: Unknown
Boiler interlock: Yes

## Main heating Control:

Main heating Control: Charging system linked to use of community heating, programmer and at least two room thermostats
Control code: 2312

## Secondary heating system:

Secondary heating system: None

## Water heating:

Water heating: From main heating system
Water code: 901
Fuel :mains gas
No hot water cylinder
Solar panel: False

## Others:

Electricity tariff: Standard Tariff
In Smoke Control Area: Unknown
Conservatory: No conservatory
Low energy lights: 100%
Terrain type: Low rise urban / suburban
EPC language: English
Wind turbine: No
Photovoltaics: Photovoltaic 1

# SAP Input

| | |
|---|---|
| | Installed Peak power: 0.95<br>Tilt of collector: 30°<br>Overshading: None or very little<br>Collector Orientation: South West |
| Assess Zero Carbon Home: | No |

# TFEE WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Zahid Ashraf | **Stroma Number:** | STRO001082 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.5.9 |

## Property Address: Plot 6

**Address :**

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 77.21 | (1a) x | 2.5 | (2a) = | 193.02 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 77.21 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 193.02 | (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 | | | | | | | 3 | x 10 = | 30 | (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) = | 30 | ÷ (5) = | 0.16 | (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) | 0.41 | (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) = | 0.38 | (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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.48 | 0.47 | 0.46 | 0.41 | 0.4 | 0.36 | 0.36 | 0.35 | 0.38 | 0.4 | 0.42 | 0.44 |

*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= | 0.61 | 0.61 | 0.61 | 0.59 | 0.58 | 0.56 | 0.56 | 0.56 | 0.57 | 0.58 | 0.59 | 0.6 | (24d) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.61 | 0.61 | 0.61 | 0.59 | 0.58 | 0.56 | 0.56 | 0.56 | 0.57 | 0.58 | 0.59 | 0.6 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2 | x | 1 | = | 2 | | | (26) |
| Windows Type 1 | | | 3.105 | x1/[1/( 1.4 )+ 0.04] | | = | 4.12 | | | (27) |
| Windows Type 2 | | | 6.097 | x1/[1/( 1.4 )+ 0.04] | | = | 8.08 | | | (27) |
| Windows Type 3 | | | 4.579 | x1/[1/( 1.4 )+ 0.04] | | = | 6.07 | | | (27) |
| Floor | | | 77.21 | x | 0.13 | = | 10.0373 | | | (28) |
| Walls Type1 | 78.24 | 13.78 | 64.46 | x | 0.18 | = | 11.6 | | | (29) |
| Walls Type2 | 33.81 | 2 | 31.81 | x | 0.18 | = | 5.73 | | | (29) |
| Total area of elements, m² | | | 189.26 | | | | | | | (31) |

** 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) = 47.64 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 9840.85 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 13.06 (36)

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

Total fabric heat loss (33) + (36) = 60.7 (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= | 39.13 | 38.85 | 38.57 | 37.27 | 37.03 | 35.89 | 35.89 | 35.68 | 36.33 | 37.03 | 37.52 | 38.03 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 99.83 | 99.55 | 99.27 | 97.97 | 97.73 | 96.59 | 96.59 | 96.38 | 97.03 | 97.73 | 98.22 | 98.73 | |

Average = Sum(39)$_{1…12}$ /12= 97.97 (39)

# TFEE WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.29 | 1.29 | 1.29 | 1.27 | 1.27 | 1.25 | 1.25 | 1.25 | 1.26 | 1.27 | 1.27 | 1.28 |

Average = Sum(40)$_{1...12}$ /12= 1.27 (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 2.41 (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 91.39 (43)

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

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

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 100.52 | 96.87 | 93.21 | 89.56 | 85.9 | 82.25 | 82.25 | 85.9 | 89.56 | 93.21 | 96.87 | 100.52 |

Total = Sum(44)$_{1...12}$ = 1096.62 (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= | 149.07 | 130.38 | 134.54 | 117.3 | 112.55 | 97.12 | 90 | 103.27 | 104.51 | 121.79 | 132.95 | 144.37 |

Total = Sum(45)$_{1...12}$ = 1437.84 (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)

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) |

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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= | 126.71 | 110.82 | 114.36 | 99.7 | 95.67 | 82.55 | 76.5 | 87.78 | 88.83 | 103.52 | 113 | 122.71 | (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= | 126.71 | 110.82 | 114.36 | 99.7 | 95.67 | 82.55 | 76.5 | 87.78 | 88.83 | 103.52 | 113 | 122.71 | |

Output from water heater (annual) 1…12 | 1222.17 | (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= | 31.68 | 27.71 | 28.59 | 24.93 | 23.92 | 20.64 | 19.12 | 21.95 | 22.21 | 25.88 | 28.25 | 30.68 | (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= | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 19.47 | 17.29 | 14.06 | 10.65 | 7.96 | 6.72 | 7.26 | 9.44 | 12.67 | 16.08 | 18.77 | 20.01 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 213.51 | 215.73 | 210.14 | 198.26 | 183.25 | 169.15 | 159.73 | 157.52 | 163.1 | 174.98 | 189.99 | 204.09 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | (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= | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 42.58 | 41.23 | 38.43 | 34.62 | 32.15 | 28.66 | 25.7 | 29.5 | 30.84 | 34.79 | 39.24 | 41.23 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 334.67 | 333.36 | 321.75 | 302.64 | 282.47 | 263.65 | 251.81 | 255.57 | 265.72 | 284.97 | 307.11 | 324.45 | (73) |

## 6. Solar gains:

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

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 68.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 116.78 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 159.78 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 197.98 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 221.76 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 220.15 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 212.25 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 194.51 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 173.01 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 129.07 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 82.12 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 58.67 | (77) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 36.79 | | 0.63 | x | 0.7 | = | 34.91 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 62.67 | | 0.63 | x | 0.7 | = | 59.47 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 85.75 | | 0.63 | x | 0.7 | = | 81.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 106.25 | | 0.63 | x | 0.7 | = | 100.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 119.01 | | 0.63 | x | 0.7 | = | 112.93 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 118.15 | | 0.63 | x | 0.7 | = | 112.12 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 113.91 | | 0.63 | x | 0.7 | = | 108.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 104.39 | | 0.63 | x | 0.7 | = | 99.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 92.85 | | 0.63 | x | 0.7 | = | 88.11 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 69.27 | | 0.63 | x | 0.7 | = | 65.73 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 44.07 | | 0.63 | x | 0.7 | = | 41.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 31.49 | | 0.63 | x | 0.7 | = | 29.88 | (79) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 11.28 | x | 0.63 | x | 0.7 | = | 15.79 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 22.97 | x | 0.63 | x | 0.7 | = | 32.14 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 41.38 | x | 0.63 | x | 0.7 | = | 57.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 67.96 | x | 0.63 | x | 0.7 | = | 95.1 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 91.35 | x | 0.63 | x | 0.7 | = | 127.83 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 97.38 | x | 0.63 | x | 0.7 | = | 136.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 91.1 | x | 0.63 | x | 0.7 | = | 127.49 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 72.63 | x | 0.63 | x | 0.7 | = | 101.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 50.42 | x | 0.63 | x | 0.7 | = | 70.56 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 28.07 | x | 0.63 | x | 0.7 | = | 39.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 14.2 | x | 0.63 | x | 0.7 | = | 19.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 9.21 | x | 0.63 | x | 0.7 | = | 12.89 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 119.26 | 208.39 | 299.06 | 393.9 | 462.52 | 468.55 | 447.83 | 395.21 | 331.68 | 234.08 | 143.8 | 101.45 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 453.94 | 541.76 | 620.81 | 696.54 | 744.99 | 732.2 | 699.64 | 650.77 | 597.41 | 519.04 | 450.92 | 425.9 | (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 | 0.89 | 0.75 | 0.58 | 0.64 | 0.87 | 0.98 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.56 | 19.74 | 20.02 | 20.39 | 20.71 | 20.92 | 20.98 | 20.97 | 20.82 | 20.39 | 19.91 | 19.53 | (87) |

# TFEE WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.85 | 19.85 | 19.85 | 19.87 | 19.87 | 19.88 | 19.88 | 19.88 | 19.87 | 19.87 | 19.86 | 19.86 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.95 | 0.85 | 0.65 | 0.45 | 0.5 | 0.8 | 0.97 | 0.99 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.54 | 18.72 | 19 | 19.37 | 19.67 | 19.84 | 19.87 | 19.87 | 19.77 | 19.39 | 18.9 | 18.53 | (90) |

fLA = Living area ÷ (4) = 0.41 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.96 | 19.14 | 19.42 | 19.79 | 20.09 | 20.28 | 20.32 | 20.32 | 20.2 | 19.8 | 19.31 | 18.94 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.96 | 19.14 | 19.42 | 19.79 | 20.09 | 20.28 | 20.32 | 20.32 | 20.2 | 19.8 | 19.31 | 18.94 | (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 | 0.95 | 0.86 | 0.69 | 0.5 | 0.56 | 0.82 | 0.97 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 452.46 | 537.69 | 609.23 | 659.89 | 641.05 | 504.67 | 351.92 | 364.93 | 490 | 501.25 | 447.9 | 424.86 | (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= | 1463.29 | 1417.2 | 1282.31 | 1066.52 | 820.4 | 548.52 | 359.76 | 377.74 | 591.88 | 898.78 | 1199.65 | 1454.96 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 752.05 | 591.03 | 500.77 | 292.77 | 133.44 | 0 | 0 | 0 | 0 | 295.76 | 541.26 | 766.39 | |

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3873.48 (98)

Space heating requirement in kWh/m²/year 50.17 (99)

## 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 | 907.96 | 714.78 | 732.5 | 0 | 0 | 0 | 0 | (100) |
| Utilisation factor for loss hm | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.84 | 0.91 | 0.88 | 0 | 0 | 0 | 0 | (101) |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 763.5 | 647.92 | 644.72 | 0 | 0 | 0 | 0 | (102) |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 945.59 | 905.7 | 850.12 | 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 | 131.1 | 191.79 | 152.82 | 0 | 0 | 0 | 0 |

Total = $Sum(104)_{6...8}$ = 475.71 (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 = $Sum(104)_{6...8}$* = 0 (106)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (107)m= | 0 | 0 | 0 | 0 | 0 | 32.78 | 47.95 | 38.21 | 0 | 0 | 0 | 0 |

Total = Sum(107) = 118.93 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.54 (108)

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

Fabric Energy Efficiency (99) + (108) = 51.71 (109)

**Target Fabric Energy Efficiency (TFEE)** 59.46 (109)

# SAP WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Zahid Ashraf | **Stroma Number:** | STRO001082 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.5.9 |

## Property Address: Plot 6

**Address :**

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 77.21 | (1a) x | 2.5 | (2a) = | 193.02 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 77.21 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 193.02 | (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) = 79.05 (23c)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.28 | 0.28 | 0.27 | 0.26 | 0.25 | 0.24 | 0.24 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | (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= | 0.28 | 0.28 | 0.27 | 0.26 | 0.25 | 0.24 | 0.24 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | (25) |

## 3. Heat losses and heat loss parameter:

| **ELEMENT** | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2 | x | 1.4 | = | 2.8 | | | (26) |
| Windows Type 1 | | | 3.105 | x1/[1/( 1.4 )+ 0.04] | | = | 4.12 | | | (27) |
| Windows Type 2 | | | 6.097 | x1/[1/( 1.4 )+ 0.04] | | = | 8.08 | | | (27) |
| Windows Type 3 | | | 4.579 | x1/[1/( 1.4 )+ 0.04] | | = | 6.07 | | | (27) |
| Floor | | | 77.21 | x | 0.12 | = | 9.2652 | | | (28) |
| Walls Type1 | 78.24 | 13.78 | 64.46 | x | 0.15 | = | 9.67 | | | (29) |
| Walls Type2 | 33.81 | 2 | 31.81 | x | 0.14 | = | 4.48 | | | (29) |
| Total area of elements, m² | | | 189.26 | | | | | | | (31) |

** 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) = 44.49 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 9840.85 (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 14.5 (36)

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

Total fabric heat loss (33) + (36) = 58.99 (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= | 17.94 | 17.72 | 17.5 | 16.39 | 16.17 | 15.07 | 15.07 | 14.85 | 15.51 | 16.17 | 16.62 | 17.06 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 76.93 | 76.71 | 76.49 | 75.39 | 75.16 | 74.06 | 74.06 | 73.84 | 74.5 | 75.16 | 75.61 | 76.05 | |

Average = $Sum(39)_{1…12}$ /12= 75.33 (39)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1 | 0.99 | 0.99 | 0.98 | 0.97 | 0.96 | 0.96 | 0.96 | 0.96 | 0.97 | 0.98 | 0.98 |

Average = Sum(40)1…12 /12= 0.98 (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 2.41 (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 96.19 (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= | 105.81 | 101.97 | 98.12 | 94.27 | 90.42 | 86.58 | 86.58 | 90.42 | 94.27 | 98.12 | 101.97 | 105.81 |

Total = Sum(44)1…12 = 1154.34 (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= | 156.92 | 137.24 | 141.62 | 123.47 | 118.47 | 102.23 | 94.73 | 108.71 | 110.01 | 128.2 | 139.94 | 151.97 |

Total = Sum(45)1…12 = 1513.52 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.54 | 20.59 | 21.24 | 18.52 | 17.77 | 15.33 | 14.21 | 16.31 | 16.5 | 19.23 | 20.99 | 22.8 | (46) |

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (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= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (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) |

# SAP WorkSheet: New dwelling design stage

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= | 212.2 | 187.17 | 196.9 | 176.96 | 173.75 | 155.73 | 150.01 | 163.98 | 163.5 | 183.48 | 193.44 | 207.24 | (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= | 212.2 | 187.17 | 196.9 | 176.96 | 173.75 | 155.73 | 150.01 | 163.98 | 163.5 | 183.48 | 193.44 | 207.24 | |

Output from water heater (annual)$_{1...12}$ 2164.36 (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= | 96.4 | 85.58 | 91.31 | 83.85 | 83.61 | 76.79 | 75.72 | 80.37 | 79.37 | 86.85 | 89.33 | 94.75 | (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= | 144.47 | 144.47 | 144.47 | 144.47 | 144.47 | 144.47 | 144.47 | 144.47 | 144.47 | 144.47 | 144.47 | 144.47 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| (67)m= | 48.67 | 43.23 | 35.15 | 26.61 | 19.89 | 16.8 | 18.15 | 23.59 | 31.66 | 40.2 | 46.92 | 50.02 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| (68)m= | 318.67 | 321.98 | 313.65 | 295.91 | 273.51 | 252.47 | 238.4 | 235.1 | 243.43 | 261.17 | 283.57 | 304.61 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| (69)m= | 51.85 | 51.85 | 51.85 | 51.85 | 51.85 | 51.85 | 51.85 | 51.85 | 51.85 | 51.85 | 51.85 | 51.85 | (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= | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| (72)m= | 129.57 | 127.34 | 122.73 | 116.46 | 112.38 | 106.65 | 101.77 | 108.02 | 110.24 | 116.73 | 124.06 | 127.35 | (72) |
| **Total internal gains =** | (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | | | | | | |
| (73)m= | 596.92 | 592.56 | 571.54 | 538.99 | 505.8 | 475.92 | 458.34 | 466.72 | 485.34 | 518.12 | 554.56 | 582 | (73) |

## 6. Solar gains:

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

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 68.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 116.78 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 159.78 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 197.98 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 221.76 | (77) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 6.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 220.15 | (77) |
| Southeast 0.9x | 0.77 | x | 6.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 212.25 | (77) |
| Southeast 0.9x | 0.77 | x | 6.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 194.51 | (77) |
| Southeast 0.9x | 0.77 | x | 6.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 173.01 | (77) |
| Southeast 0.9x | 0.77 | x | 6.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 129.07 | (77) |
| Southeast 0.9x | 0.77 | x | 6.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 82.12 | (77) |
| Southeast 0.9x | 0.77 | x | 6.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 58.67 | (77) |
| Southwest 0.9x | 0.77 | x | 3.11 | x | 36.79 | | 0.63 | x | 0.7 | = | 34.91 | (79) |
| Southwest 0.9x | 0.77 | x | 3.11 | x | 62.67 | | 0.63 | x | 0.7 | = | 59.47 | (79) |
| Southwest 0.9x | 0.77 | x | 3.11 | x | 85.75 | | 0.63 | x | 0.7 | = | 81.37 | (79) |
| Southwest 0.9x | 0.77 | x | 3.11 | x | 106.25 | | 0.63 | x | 0.7 | = | 100.83 | (79) |
| Southwest 0.9x | 0.77 | x | 3.11 | x | 119.01 | | 0.63 | x | 0.7 | = | 112.93 | (79) |
| Southwest 0.9x | 0.77 | x | 3.11 | x | 118.15 | | 0.63 | x | 0.7 | = | 112.12 | (79) |
| Southwest 0.9x | 0.77 | x | 3.11 | x | 113.91 | | 0.63 | x | 0.7 | = | 108.09 | (79) |
| Southwest 0.9x | 0.77 | x | 3.11 | x | 104.39 | | 0.63 | x | 0.7 | = | 99.06 | (79) |
| Southwest 0.9x | 0.77 | x | 3.11 | x | 92.85 | | 0.63 | x | 0.7 | = | 88.11 | (79) |
| Southwest 0.9x | 0.77 | x | 3.11 | x | 69.27 | | 0.63 | x | 0.7 | = | 65.73 | (79) |
| Southwest 0.9x | 0.77 | x | 3.11 | x | 44.07 | | 0.63 | x | 0.7 | = | 41.82 | (79) |
| Southwest 0.9x | 0.77 | x | 3.11 | x | 31.49 | | 0.63 | x | 0.7 | = | 29.88 | (79) |
| Northwest 0.9x | 0.77 | x | 4.58 | x | 11.28 | x | 0.63 | x | 0.7 | = | 15.79 | (81) |
| Northwest 0.9x | 0.77 | x | 4.58 | x | 22.97 | x | 0.63 | x | 0.7 | = | 32.14 | (81) |
| Northwest 0.9x | 0.77 | x | 4.58 | x | 41.38 | x | 0.63 | x | 0.7 | = | 57.91 | (81) |
| Northwest 0.9x | 0.77 | x | 4.58 | x | 67.96 | x | 0.63 | x | 0.7 | = | 95.1 | (81) |
| Northwest 0.9x | 0.77 | x | 4.58 | x | 91.35 | x | 0.63 | x | 0.7 | = | 127.83 | (81) |
| Northwest 0.9x | 0.77 | x | 4.58 | x | 97.38 | x | 0.63 | x | 0.7 | = | 136.28 | (81) |
| Northwest 0.9x | 0.77 | x | 4.58 | x | 91.1 | x | 0.63 | x | 0.7 | = | 127.49 | (81) |
| Northwest 0.9x | 0.77 | x | 4.58 | x | 72.63 | x | 0.63 | x | 0.7 | = | 101.63 | (81) |
| Northwest 0.9x | 0.77 | x | 4.58 | x | 50.42 | x | 0.63 | x | 0.7 | = | 70.56 | (81) |
| Northwest 0.9x | 0.77 | x | 4.58 | x | 28.07 | x | 0.63 | x | 0.7 | = | 39.28 | (81) |
| Northwest 0.9x | 0.77 | x | 4.58 | x | 14.2 | x | 0.63 | x | 0.7 | = | 19.87 | (81) |
| Northwest 0.9x | 0.77 | x | 4.58 | x | 9.21 | x | 0.63 | x | 0.7 | = | 12.89 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 119.26 | 208.39 | 299.06 | 393.9 | 462.52 | 468.55 | 447.83 | 395.21 | 331.68 | 234.08 | 143.8 | 101.45 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 716.18 | 800.95 | 870.6 | 932.89 | 968.32 | 944.47 | 906.17 | 861.92 | 817.02 | 752.19 | 698.37 | 683.44 | (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= | 0.91 | 0.87 | 0.82 | 0.73 | 0.61 | 0.47 | 0.35 | 0.38 | 0.56 | 0.76 | 0.87 | 0.92 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.45 | 19.69 | 20.04 | 20.44 | 20.74 | 20.92 | 20.97 | 20.97 | 20.85 | 20.48 | 19.91 | 19.4 | (87) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.09 | 20.09 | 20.09 | 20.1 | 20.11 | 20.12 | 20.12 | 20.12 | 20.11 | 20.11 | 20.1 | 20.1 | | (88) |

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

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.9 | 0.86 | 0.8 | 0.71 | 0.57 | 0.41 | 0.28 | 0.31 | 0.5 | 0.72 | 0.85 | 0.91 | | (89) |

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

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.04 | 18.38 | 18.87 | 19.43 | 19.82 | 20.04 | 20.1 | 20.1 | 19.97 | 19.49 | 18.71 | 17.98 | | (90) |

fLA = Living area ÷ (4) = 0.41 (91)

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

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.61 | 18.92 | 19.35 | 19.84 | 20.2 | 20.4 | 20.46 | 20.45 | 20.33 | 19.89 | 19.2 | 18.56 | | (92) |

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

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.61 | 18.92 | 19.35 | 19.84 | 20.2 | 20.4 | 20.46 | 20.45 | 20.33 | 19.89 | 19.2 | 18.56 | | (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= | 0.87 | 0.84 | 0.78 | 0.7 | 0.58 | 0.43 | 0.31 | 0.34 | 0.52 | 0.72 | 0.83 | 0.88 | | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | | |
| (95)m= | 625.75 | 671.58 | 683.08 | 649.34 | 557.73 | 405.1 | 278.86 | 290.21 | 421.06 | 538.31 | 581.9 | 604.25 | | (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= | 1100.95 | 1075.22 | 982.65 | 824.91 | 638.66 | 429.45 | 285.56 | 299.07 | 464.28 | 698.61 | 914.64 | 1091.74 | | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | | |
| (98)m= | 353.55 | 271.24 | 222.88 | 126.41 | 60.21 | 0 | 0 | 0 | 0 | 119.27 | 239.57 | 362.69 | | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1755.82 (98)

Space heating requirement in kWh/m²/year 22.74 (99)

## 9b. Energy requirements – Community heating scheme

| | | |
|---|---|---|
| This part is used for space heating, space cooling or water heating provided by a community scheme.<br>Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community boilers | | 1 | (303a) |
| Fraction of total space heat from Community boilers | (302) x (303a) = | 1 | (304a) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 1755.82 | |
| Space heat from Community boilers | (98) x (304a) x (305) x (306) = | 1843.61 | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |

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| | | | |
|---|---|---|---|
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |

**Water heating**

| | | | |
|---|---|---|---|
| Annual water heating requirement | | 2164.36 | |
| If DHW from community scheme: Water heat from Community boilers | (64) x (303a) x (305) x (306) = | 2272.58 | (310a) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 41.16 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside | | 267.87 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 267.87 | (331) |
| Energy for lighting (calculated in Appendix L) | | 343.8 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -782.18 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 10b. Fuel costs – Community heating scheme

| | **Fuel** kWh/year | **Fuel Price** (Table 12) | | **Fuel Cost** £/year | |
|---|---|---|---|---|---|
| Space heating from CHP | (307a) x | 4.24 | x 0.01 = | 78.17 | (340a) |
| Water heating from CHP | (310a) x | 4.24 | x 0.01 = | 96.36 | (342a) |
| | | **Fuel Price** | | | |
| Pumps and fans | (331) | 13.19 | x 0.01 = | 35.33 | (349) |
| Energy for lighting | (332) | 13.19 | x 0.01 = | 45.35 | (350) |
| Additional standing charges (Table 12) | | | | 120 | (351) |
| Energy saving/generation technologies | | | | | |
| **Total energy cost** | = (340a)…(342e) + (345)…(354) = | | | 375.21 | (355) |

## 11b. SAP rating - Community heating scheme

| | | | |
|---|---|---|---|
| Energy cost deflator (Table 12) | | 0.42 | (356) |
| Energy cost factor (ECF) | [(355) x (356)] ÷ [(4) + 45.0] = | 1.29 | (357) |
| **SAP rating (section12)** | | 82.01 | (358) |

## 12b. CO2 Emissions – Community heating scheme

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | 94 | (367a) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.22 | = | 945.85 | (367) |
| Electrical energy for heat distribution | [(313) x | 0.52 | = | 21.36 | (372) |

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| | | | | | |
|---|---|---|---|---|---|
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | = | 967.21 | (373) |
| CO2 associated with space heating (secondary) | (309) x | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | 0.22 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | 967.21 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | 0.52 | = | 139.02 | (378) |
| CO2 associated with electricity for lighting | (332))) x | 0.52 | = | 178.43 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | x 0.01 = | -405.95 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | 878.72 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | 11.38 | (384) |
| **EI rating (section 14)** | | | | 90.37 | (385) |

## 13b. Primary Energy – Community heating scheme

| | | **Energy kWh/year** | **Primary factor** | | **P.Energy kWh/year** | |
|---|---|---|---|---|---|---|
| Energy from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 94 | (367a) |
| Energy associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 1.22 | = | 5342.28 | (367) |
| Electrical energy for heat distribution | [(313) x | | | = | 126.37 | (372) |
| Total Energy associated with community systems | (363)…(366) + (368)...(372) | | | = | 5468.65 | (373) |
| *if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)* | | | | | 5468.65 | (373) |
| Energy associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| Energy associated with water from immersion heater or instantaneous heater | (312) x | | 1.22 | = | 0 | (375) |
| Total Energy associated with space and water heating | (373) + (374) + (375) = | | | | 5468.65 | (376) |
| Energy associated with space cooling | (315) x | | 3.07 | = | 0 | (377) |
| Energy associated with electricity for pumps and fans within dwelling | (331)) x | | 3.07 | = | 822.36 | (378) |
| Energy associated with electricity for lighting | (332))) x | | 3.07 | = | 1055.48 | (379) |
| Energy saving/generation technologies<br>Item 1 | | | 3.07 | x 0.01 = | -2401.3 | (380) |
| **Total Primary Energy, kWh/year** | sum of (376)…(382) = | | | | 4945.2 | (383) |

# TER WorkSheet: New dwelling design stage

User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Zahid Ashraf | **Stroma Number:** | STRO001082 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.5.9 |

Property Address: Plot 6

**Address :**

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 77.21 | (1a) x | 2.5 | (2a) = | 193.02 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 77.21 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 193.02 | (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 | | | | | | | 3 | x 10 = | 30 | (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) = | 30 | ÷ (5) = | 0.16 | (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) | 0.41 | (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) = | 0.38 | (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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.48 | 0.47 | 0.46 | 0.41 | 0.4 | 0.36 | 0.36 | 0.35 | 0.38 | 0.4 | 0.42 | 0.44 |

*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= | 0.61 | 0.61 | 0.61 | 0.59 | 0.58 | 0.56 | 0.56 | 0.56 | 0.57 | 0.58 | 0.59 | 0.6 | (24d) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.61 | 0.61 | 0.61 | 0.59 | 0.58 | 0.56 | 0.56 | 0.56 | 0.57 | 0.58 | 0.59 | 0.6 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2 | x | 1 | = | 2 | | | (26) |
| Windows Type 1 | | | 3.105 | x1/[1/( 1.4 )+ 0.04] | | = | 4.12 | | | (27) |
| Windows Type 2 | | | 6.097 | x1/[1/( 1.4 )+ 0.04] | | = | 8.08 | | | (27) |
| Windows Type 3 | | | 4.579 | x1/[1/( 1.4 )+ 0.04] | | = | 6.07 | | | (27) |
| Floor | | | 77.21 | x | 0.13 | = | 10.0373 | | | (28) |
| Walls Type1 | 78.24 | 13.78 | 64.46 | x | 0.18 | = | 11.6 | | | (29) |
| Walls Type2 | 33.81 | 2 | 31.81 | x | 0.18 | = | 5.73 | | | (29) |
| Total area of elements, m² | | | 189.26 | | | | | | | (31) |

** 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) = 47.64 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 9840.85 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 13.06 (36)

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

Total fabric heat loss (33) + (36) = 60.7 (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= | 39.13 | 38.85 | 38.57 | 37.27 | 37.03 | 35.89 | 35.89 | 35.68 | 36.33 | 37.03 | 37.52 | 38.03 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 99.83 | 99.55 | 99.27 | 97.97 | 97.73 | 96.59 | 96.59 | 96.38 | 97.03 | 97.73 | 98.22 | 98.73 | |

Average = $Sum(39)_{1…12}$ /12= 97.97 (39)

# TER WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.29 | 1.29 | 1.29 | 1.27 | 1.27 | 1.25 | 1.25 | 1.25 | 1.26 | 1.27 | 1.27 | 1.28 |

Average = Sum(40)1…12 /12= 1.27 (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 2.41 (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 91.39 (43)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | |
| (44)m= | 100.52 | 96.87 | 93.21 | 89.56 | 85.9 | 82.25 | 82.25 | 85.9 | 89.56 | 93.21 | 96.87 | 100.52 |

Total = Sum(44)1…12 = 1096.62 (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= | 149.07 | 130.38 | 134.54 | 117.3 | 112.55 | 97.12 | 90 | 103.27 | 104.51 | 121.79 | 132.95 | 144.37 |

Total = Sum(45)1…12 = 1437.84 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 22.36 | 19.56 | 20.18 | 17.59 | 16.88 | 14.57 | 13.5 | 15.49 | 15.68 | 18.27 | 19.94 | 21.66 | (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (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) 0.75 (55)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | (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= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | (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) |

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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= | 195.67 | 172.47 | 181.14 | 162.39 | 159.14 | 142.21 | 136.59 | 149.87 | 149.6 | 168.39 | 178.04 | 190.96 | (62) |

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

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

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

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 195.67 | 172.47 | 181.14 | 162.39 | 159.14 | 142.21 | 136.59 | 149.87 | 149.6 | 168.39 | 178.04 | 190.96 | |

Output from water heater (annual)$_{1...12}$ 1986.46 (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= | 86.84 | 77.02 | 82.01 | 75.07 | 74.7 | 68.37 | 67.2 | 71.61 | 70.82 | 77.77 | 80.28 | 85.28 | (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= | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | 120.39 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 19.47 | 17.29 | 14.06 | 10.65 | 7.96 | 6.72 | 7.26 | 9.44 | 12.67 | 16.08 | 18.77 | 20.01 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 213.51 | 215.73 | 210.14 | 198.26 | 183.25 | 169.15 | 159.73 | 157.52 | 163.1 | 174.98 | 189.99 | 204.09 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | 35.04 | (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= | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | -96.31 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 116.72 | 114.61 | 110.23 | 104.27 | 100.4 | 94.95 | 90.32 | 96.26 | 98.36 | 104.53 | 111.5 | 114.62 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 411.82 | 409.75 | 396.55 | 375.29 | 353.73 | 332.94 | 319.43 | 325.32 | 336.24 | 357.71 | 382.37 | 400.84 | (73) |

## 6. Solar gains:

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

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 6.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 68.56 | (77) |
| Southeast 0.9x | 0.77 | x | 6.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 116.78 | (77) |
| Southeast 0.9x | 0.77 | x | 6.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 159.78 | (77) |
| Southeast 0.9x | 0.77 | x | 6.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 197.98 | (77) |
| Southeast 0.9x | 0.77 | x | 6.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 221.76 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 220.15 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 212.25 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 194.51 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 173.01 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 129.07 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 82.12 | (77) |
| Southeast | 0.9x | 0.77 | x | 6.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 58.67 | (77) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 36.79 | | 0.63 | x | 0.7 | = | 34.91 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 62.67 | | 0.63 | x | 0.7 | = | 59.47 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 85.75 | | 0.63 | x | 0.7 | = | 81.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 106.25 | | 0.63 | x | 0.7 | = | 100.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 119.01 | | 0.63 | x | 0.7 | = | 112.93 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 118.15 | | 0.63 | x | 0.7 | = | 112.12 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 113.91 | | 0.63 | x | 0.7 | = | 108.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 104.39 | | 0.63 | x | 0.7 | = | 99.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 92.85 | | 0.63 | x | 0.7 | = | 88.11 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 69.27 | | 0.63 | x | 0.7 | = | 65.73 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 44.07 | | 0.63 | x | 0.7 | = | 41.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.11 | x | 31.49 | | 0.63 | x | 0.7 | = | 29.88 | (79) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 11.28 | x | 0.63 | x | 0.7 | = | 15.79 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 22.97 | x | 0.63 | x | 0.7 | = | 32.14 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 41.38 | x | 0.63 | x | 0.7 | = | 57.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 67.96 | x | 0.63 | x | 0.7 | = | 95.1 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 91.35 | x | 0.63 | x | 0.7 | = | 127.83 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 97.38 | x | 0.63 | x | 0.7 | = | 136.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 91.1 | x | 0.63 | x | 0.7 | = | 127.49 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 72.63 | x | 0.63 | x | 0.7 | = | 101.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 50.42 | x | 0.63 | x | 0.7 | = | 70.56 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 28.07 | x | 0.63 | x | 0.7 | = | 39.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 14.2 | x | 0.63 | x | 0.7 | = | 19.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 4.58 | x | 9.21 | x | 0.63 | x | 0.7 | = | 12.89 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 119.26 | 208.39 | 299.06 | 393.9 | 462.52 | 468.55 | 447.83 | 395.21 | 331.68 | 234.08 | 143.8 | 101.45 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 531.08 | 618.14 | 695.62 | 769.19 | 816.25 | 801.49 | 767.26 | 720.53 | 667.93 | 591.79 | 526.18 | 502.28 | (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 | 0.95 | 0.86 | 0.7 | 0.54 | 0.59 | 0.83 | 0.96 | 0.99 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.65 | 19.83 | 20.1 | 20.46 | 20.76 | 20.94 | 20.99 | 20.98 | 20.86 | 20.47 | 20 | 19.62 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.85 | 19.85 | 19.85 | 19.87 | 19.87 | 19.88 | 19.88 | 19.88 | 19.87 | 19.87 | 19.86 | 19.86 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.97 | 0.93 | 0.81 | 0.61 | 0.41 | 0.46 | 0.74 | 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= | 18.07 | 18.33 | 18.73 | 19.24 | 19.63 | 19.84 | 19.87 | 19.87 | 19.77 | 19.27 | 18.59 | 18.04 | (90) |

fLA = Living area ÷ (4) = 0.41 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.71 | 18.94 | 19.29 | 19.73 | 20.09 | 20.28 | 20.33 | 20.32 | 20.21 | 19.76 | 19.16 | 18.68 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.71 | 18.94 | 19.29 | 19.73 | 20.09 | 20.28 | 20.33 | 20.32 | 20.21 | 19.76 | 19.16 | 18.68 | (93) |

## 8. Space heating requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.99 | 0.99 | 0.97 | 0.93 | 0.83 | 0.64 | 0.46 | 0.51 | 0.77 | 0.95 | 0.99 | 0.99 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 527.58 | 609.9 | 675.15 | 712.63 | 673.56 | 516.05 | 354.46 | 369.25 | 515.43 | 559.46 | 519.33 | 499.69 | (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= | 1438.91 | 1397.39 | 1269.35 | 1061.48 | 820.11 | 549.1 | 359.99 | 378.1 | 592.9 | 894.79 | 1184.56 | 1430.03 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 678.03 | 529.19 | 442.08 | 251.17 | 109.03 | 0 | 0 | 0 | 0 | 249.48 | 478.97 | 692.17 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3430.12 (98)

Space heating requirement in kWh/m²/year 44.43 (99)

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

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.5 | (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) | | | | | | | | | | | | | |
| | 678.03 | 529.19 | 442.08 | 251.17 | 109.03 | 0 | 0 | 0 | 0 | 249.48 | 478.97 | 692.17 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 725.16 | 565.98 | 472.82 | 268.63 | 116.61 | 0 | 0 | 0 | 0 | 266.83 | 512.26 | 740.29 | |

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3668.58 (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)

# TER WorkSheet: New dwelling design stage

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 195.67 | 172.47 | 181.14 | 162.39 | 159.14 | 142.21 | 136.59 | 149.87 | 149.6 | 168.39 | 178.04 | 190.96 | |
| Efficiency of water heater | | | | | | | | | | | | 79.8 | (216) |
| (217)m= | 87.86 | 87.61 | 87.11 | 85.97 | 83.83 | 79.8 | 79.8 | 79.8 | 79.8 | 85.86 | 87.33 | 87.95 | (217) |

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 222.7 | 196.85 | 207.95 | 188.88 | 189.84 | 178.21 | 171.17 | 187.8 | 187.47 | 196.12 | 203.87 | 217.13 | |

Total = Sum(219a)$_{1...12}$ = 2347.99 (219)

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 3668.58 | |
| Water heating fuel used | | | 2347.99 | |
| 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 | | | 343.8 | (232) |

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

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 792.41 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 507.17 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1299.58 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 178.43 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1516.94 | (272) |

**TER =** 19.65 (273)