

# Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.18  
Printed on 16 July 2019 at 15:43:17

## Project Information:

**Assessed By:** Gerard Mcguigan (STRO011196)

**Building Type:** Semi-detached House

## Dwelling Details:

### NEW DWELLING DESIGN STAGE

Total Floor Area: 107.2m<sup>2</sup>

**Site Reference :** Hedgerows Westgate

**Plot Reference:** Plot 125

**Address :** Plot 125, The Hedgerows, Westergate, PO20

## Client Details:

**Name:** Taylor Wimpey Southern Counties

**Address :** Colvedene Court, Wessex Business Park, Colden Common, Hampshire, SO21 1WP

**This report covers items included within the SAP calculations.**

**It is not a complete report of regulations compliance.**

## 1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 16.29 kg/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 15.65 kg/m<sup>2</sup> OK

## 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 47.1 kWh/m<sup>2</sup>

Dwelling Fabric Energy Efficiency (DFEE) 43.3 kWh/m<sup>2</sup> OK

## 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.25 (max. 0.30) | 0.25 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | 0.15 (max. 0.25) | 0.15 (max. 0.70) | OK |
| Roof          | 0.11 (max. 0.20) | 0.11 (max. 0.35) | OK |
| Openings      | 1.39 (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 | 7.00 (design value) |    |
| Maximum                        | 10.0                | OK |

## 4 Heating efficiency

|                           |                                                                                                                                                                                                                                                   |    |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Main Heating system:      | Database: (rev 444, product index 017929):<br>Boiler systems with radiators or underfloor heating - mains gas<br>Brand name: Ideal<br>Model: LOGIC COMBI<br>Model qualifier: ESP1 35<br>(Combi)<br>Efficiency 89.6 % SEDBUK2009<br>Minimum 88.0 % | OK |
| Secondary heating system: | None                                                                                                                                                                                                                                              |    |

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## 5 Cylinder insulation

Hot water Storage: No cylinder

## 6 Controls

Space heating controls TTZC by plumbing and electrical services OK  
 Hot water controls: No cylinder thermostat  
 No cylinder  
 Boiler interlock: Yes OK

## 7 Low energy lights

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

## 8 Mechanical ventilation

Continuous extract system (decentralised)  
 Specific fan power: 0.16 0.18  
 Maximum 0.7 OK

## 9 Summer time temperatures

Overheating risk (South England): Slight OK

Based on:

Overshading: Average or unknown  
 Windows facing: North 5.35m<sup>2</sup>  
 Windows facing: South 6.9m<sup>2</sup>  
 Ventilation rate: 4.00  
 Blinds/curtains: None

## 10 Key features

Thermal bridging 0.037 W/m<sup>2</sup>K  
 Roofs U-value 0.11 W/m<sup>2</sup>K  
 Party Walls U-value 0 W/m<sup>2</sup>K

# SAP WorkSheet: New dwelling design stage

## User Details

**Assessor Name:** Gerard Mcguigan **Stroma Number:** STRO011196  
**Software Name:** Stroma FSAP 2012 **Software Version:** Version: 1.0.4.18

## Property Address: Plot 125

**Address :** Plot 125, The Hedgerows, Westergate, PO20

## 1. General dwelling dimensions

|                                                           | Area(m <sup>2</sup> ) |        | Av. Height(m) |                                      | Volume(m <sup>3</sup> ) |
|-----------------------------------------------------------|-----------------------|--------|---------------|--------------------------------------|-------------------------|
| Ground floor                                              | 53.6                  | (1a) x | 2.3           | (2a) =                               | 123.28 (3a)             |
| First floor                                               | 53.6                  | (1b) x | 2.6           | (2b) =                               | 139.36 (3b)             |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 107.2                 | (4)    |               |                                      |                         |
| Dwelling volume                                           |                       |        |               | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 262.64 (5)              |

## 2. Ventilation rate

|                              | main heating |   | secondary heating |   | other |   | total |        | m <sup>3</sup> 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)     |
| <i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>                              |                                          |               |           |
| 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)    |
| <i>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</i> |                                          |               |           |
| 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                                                      |                                          |               | 7 (17)    |
| If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)                                                               |                                          |               | 0.35 (18) |
| <i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>                                |                                          |               |           |
| Number of sides sheltered                                                                                                                              |                                          |               | 2 (19)    |
| Shelter factor                                                                                                                                         | (20) = 1 - {0.075 x (19)} =              |               | 0.85 (20) |
| Infiltration rate incorporating shelter factor                                                                                                         | (21) = (18) x (20) =                     |               | 0.3 (21)  |
| Infiltration rate modified for monthly wind speed                                                                                                      |                                          |               |           |

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

Monthly average wind speed from Table 7

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

# SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

|  |      |      |      |      |      |      |      |      |     |      |      |      |
|--|------|------|------|------|------|------|------|------|-----|------|------|------|
|  | 0.38 | 0.37 | 0.36 | 0.33 | 0.32 | 0.28 | 0.28 | 0.28 | 0.3 | 0.32 | 0.33 | 0.35 |
|--|------|------|------|------|------|------|------|------|-----|------|------|------|

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a) 0.5

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

(23b) 0.5

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

(23c) 0

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

|         |      |      |      |      |      |      |      |      |      |      |      |     |
|---------|------|------|------|------|------|------|------|------|------|------|------|-----|
| (24c)m= | 0.63 | 0.62 | 0.61 | 0.58 | 0.57 | 0.53 | 0.53 | 0.53 | 0.55 | 0.57 | 0.58 | 0.6 |
|---------|------|------|------|------|------|------|------|------|------|------|------|-----|

(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= | 0.63 | 0.62 | 0.61 | 0.58 | 0.57 | 0.53 | 0.53 | 0.53 | 0.55 | 0.57 | 0.58 | 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                      |                 |             | 2.1            | 1.3                         | 2.73        |                 | (26)         |
| Windows Type 1             |                 |             | 5.35           | $\times 1/[1/(1.4) + 0.04]$ | 7.09        |                 | (27)         |
| Windows Type 2             |                 |             | 6.9            | $\times 1/[1/(1.4) + 0.04]$ | 9.15        |                 | (27)         |
| Floor                      |                 |             | 53.6           | 0.15                        | 8.04        | 75              | 4020 (28)    |
| Walls                      | 101.67          | 14.35       | 87.32          | 0.25                        | 21.83       | 60              | 5239.2 (29)  |
| Roof                       | 53.6            | 0           | 53.6           | 0.11                        | 5.9         | 9               | 482.4 (30)   |
| Total area of elements, m² |                 |             | 208.87         |                             |             |                 | (31)         |
| Party wall                 |                 |             | 45.82          | 0                           | 0           | 70              | 3207.4 (32)  |
| Internal wall **           |                 |             | 161.3          |                             |             | 9               | 1451.7 (32c) |
| Internal floor             |                 |             | 53.6           |                             |             | 18              | 964.8 (32d)  |
| Internal ceiling           |                 |             | 53.6           |                             |             | 9               | 482.4 (32e)  |

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[(1/U\text{-value})+0.04]$  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) =

54.74 (33)

Heat capacity Cm = S(A x k)

((23)...(30) + (32) + (32a)...(32e) =

15847.9 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K

= (34) ÷ (4) =

147.83 (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.

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

7.68 (36)

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

Total fabric heat loss

(33) + (36) =

62.41 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

|        | Jan   | Feb  | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| (38)m= | 54.54 | 53.9 | 53.25 | 50.03 | 49.39 | 46.16 | 46.16 | 45.52 | 47.45 | 49.39 | 50.68 | 51.96 |

(38)

Heat transfer coefficient, W/K

(39)m = (37) ÷ (38)m

|        |        |        |        |        |       |        |        |        |        |       |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|-------|--------|--------|
| (39)m= | 116.96 | 116.31 | 115.67 | 112.44 | 111.8 | 108.58 | 108.58 | 107.93 | 109.87 | 111.8 | 113.09 | 114.38 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|-------|--------|--------|

Average = Sum(39)<sub>1...12</sub> / 12 =

112.28 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

|        |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| (40)m= | 1.09 | 1.08 | 1.08 | 1.05 | 1.04 | 1.01 | 1.01 | 1.01 | 1.02 | 1.04 | 1.05 | 1.07 |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|

Average = Sum(40)<sub>1...12</sub> / 12 =

1.05 (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

2.8

(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

100.63

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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= | 110.69 | 106.66 | 102.64 | 98.61 | 94.59 | 90.56 | 90.56 | 94.59 | 98.61 | 102.64 | 106.66 | 110.69 |
|--------|--------|--------|--------|-------|-------|-------|-------|-------|-------|--------|--------|--------|

Total = Sum(44)<sub>1...12</sub> =

1207.53 (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= | 164.15 | 143.57 | 148.15 | 129.16 | 123.93 | 106.94 | 99.1 | 113.72 | 115.08 | 134.11 | 146.39 | 158.97 |
|--------|--------|--------|--------|--------|--------|--------|------|--------|--------|--------|--------|--------|

Total = Sum(45)<sub>1...12</sub> =

1583.26 (45)

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| (46)m= | 24.62 | 21.53 | 22.22 | 19.37 | 18.59 | 16.04 | 14.86 | 17.06 | 17.26 | 20.12 | 21.96 | 23.85 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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)

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Energy lost from water storage, kWh/year

$$\{47\} \times \{51\} \times \{52\} \times \{53\} =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$\{56\}m = \{55\} \times \{41\}m$$

(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 × [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

(57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

(59)

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

(61)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 14.15 | 12.77 | 14.11 | 13.62 | 14.04 | 13.55 | 13.97 | 14.01 | 13.59 | 14.08 | 13.66 | 14.14 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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=

|       |        |        |        |        |        |        |        |        |        |        |        |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 178.3 | 156.34 | 162.26 | 142.78 | 137.97 | 120.49 | 113.07 | 127.73 | 128.66 | 148.19 | 160.05 | 173.11 |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(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=

|       |        |        |        |        |        |        |        |        |        |        |        |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 178.3 | 156.34 | 162.26 | 142.78 | 137.97 | 120.49 | 113.07 | 127.73 | 128.66 | 148.19 | 160.05 | 173.11 |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

Output from water heater (annual) × 1.12

1748.94

(64)

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 58.12 | 50.93 | 52.79 | 46.35 | 44.72 | 38.94 | 36.44 | 41.31 | 41.66 | 48.11 | 52.09 | 56.39 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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

(66)m=

| Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 167.82 | 167.82 | 167.82 | 167.82 | 167.82 | 167.82 | 167.82 | 167.82 | 167.82 | 167.82 | 167.82 | 167.82 |

(66)

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

(67)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 66.89 | 59.41 | 48.31 | 36.58 | 27.34 | 23.08 | 24.94 | 32.42 | 43.51 | 55.25 | 64.49 | 68.74 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(67)

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

(68)m=

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 399.21 | 403.35 | 392.91 | 370.69 | 342.64 | 316.27 | 298.66 | 294.51 | 304.95 | 327.18 | 355.23 | 381.59 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(68)

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

(69)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 54.58 | 54.58 | 54.58 | 54.58 | 54.58 | 54.58 | 54.58 | 54.58 | 54.58 | 54.58 | 54.58 | 54.58 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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=

|         |         |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

(71)

Water heating gains (Table 5)

(72)m=

|       |       |       |       |      |       |       |       |       |       |       |      |
|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|
| 78.11 | 75.79 | 70.95 | 64.37 | 60.1 | 54.09 | 48.98 | 55.53 | 57.86 | 64.67 | 72.35 | 75.8 |
|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|

(72)

Total internal gains =

$$\{66\}m + \{67\}m + \{68\}m + \{69\}m + \{70\}m + \{71\}m + \{72\}m$$

(73)m=

|        |        |        |        |       |        |       |        |        |        |        |        |
|--------|--------|--------|--------|-------|--------|-------|--------|--------|--------|--------|--------|
| 657.73 | 652.06 | 625.69 | 585.16 | 543.6 | 506.96 | 486.1 | 495.98 | 519.84 | 560.61 | 605.58 | 639.65 |
|--------|--------|--------|--------|-------|--------|-------|--------|--------|--------|--------|--------|

(73)

## 6. Solar gains

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

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| Orientation: | Access Factor<br>Table 6d |      |   | Area<br>m <sup>2</sup> | Flux<br>Table 6a |        |   | g_<br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|--------------|---------------------------|------|---|------------------------|------------------|--------|---|----------------|---|----------------|---|--------------|------|
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 10.63  | x | 0.45           | x | 1.11           | = | 19.71        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 20.32  | x | 0.45           | x | 1.11           | = | 37.67        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 34.53  | x | 0.45           | x | 1.11           | = | 64.01        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 55.46  | x | 0.45           | x | 1.11           | = | 102.82       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 74.72  | x | 0.45           | x | 1.11           | = | 138.51       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 79.99  | x | 0.45           | x | 1.11           | = | 148.27       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 74.68  | x | 0.45           | x | 1.11           | = | 138.43       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 59.25  | x | 0.45           | x | 1.11           | = | 109.83       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 41.52  | x | 0.45           | x | 1.11           | = | 76.96        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 24.19  | x | 0.45           | x | 1.11           | = | 44.84        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 13.12  | x | 0.45           | x | 1.11           | = | 24.32        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 8.86   | x | 0.45           | x | 1.11           | = | 16.43        | (74) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 46.75  | x | 0.45           | x | 1.11           | = | 111.78       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 76.57  | x | 0.45           | x | 1.11           | = | 183.06       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 97.53  | x | 0.45           | x | 1.11           | = | 233.19       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 110.23 | x | 0.45           | x | 1.11           | = | 263.55       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 114.87 | x | 0.45           | x | 1.11           | = | 274.64       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 110.55 | x | 0.45           | x | 1.11           | = | 264.3        | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 108.01 | x | 0.45           | x | 1.11           | = | 258.24       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 104.89 | x | 0.45           | x | 1.11           | = | 250.79       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 101.89 | x | 0.45           | x | 1.11           | = | 243.59       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 82.59  | x | 0.45           | x | 1.11           | = | 197.45       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 55.42  | x | 0.45           | x | 1.11           | = | 132.49       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 40.4   | x | 0.45           | x | 1.11           | = | 96.59        | (78) |

Solar gains in watts, calculated for each month

{83}m = Sum(74)m ... (82)m

|        |        |        |       |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| {83}m= | 131.49 | 220.73 | 297.2 | 366.37 | 413.15 | 412.58 | 396.67 | 360.62 | 320.56 | 242.29 | 156.81 | 113.02 | {83} |
|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

Total gains – internal and solar {84}m = {73}m + {83}m , watts

|        |        |       |        |        |        |        |        |       |       |       |        |        |      |
|--------|--------|-------|--------|--------|--------|--------|--------|-------|-------|-------|--------|--------|------|
| {84}m= | 789.22 | 872.8 | 922.89 | 951.53 | 956.74 | 919.54 | 882.77 | 856.6 | 840.4 | 802.9 | 762.39 | 752.67 | {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 | 0.96 | 0.94 | 0.9 | 0.82 | 0.67 | 0.51 | 0.54 | 0.74 | 0.9 | 0.96 | 0.98 | {86} |

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| {87}m= | 19.44 | 19.64 | 19.93 | 20.33 | 20.65 | 20.89 | 20.97 | 20.96 | 20.82 | 20.41 | 19.88 | 19.43 | {87} |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| {88}m= | 20.01 | 20.01 | 20.02 | 20.04 | 20.05 | 20.07 | 20.07 | 20.08 | 20.06 | 20.05 | 20.04 | 20.03 | {88} |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |      |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| {89}m= | 0.97 | 0.96 | 0.93 | 0.88 | 0.77 | 0.59 | 0.42 | 0.45 | 0.68 | 0.88 | 0.95 | 0.97 | {89} |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|

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

|                           |       |       |       |       |       |       |       |       |      |       |      |       |      |
|---------------------------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|------|-------|------|
| (90)m=                    | 17.94 | 18.23 | 18.66 | 19.23 | 19.67 | 19.98 | 20.05 | 20.05 | 19.9 | 19.36 | 18.6 | 17.94 | (90) |
| fLA = Living area ÷ (4) = |       |       |       |       |       |       |       |       |      |       |      | 0.16  | (91) |

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

|        |       |       |       |      |       |       |      |      |       |       |       |       |      |
|--------|-------|-------|-------|------|-------|-------|------|------|-------|-------|-------|-------|------|
| (92)m= | 18.18 | 18.45 | 18.86 | 19.4 | 19.83 | 20.12 | 20.2 | 20.2 | 20.04 | 19.53 | 18.81 | 18.17 | (92) |
|--------|-------|-------|-------|------|-------|-------|------|------|-------|-------|-------|-------|------|

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

|        |       |      |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (93)m= | 18.03 | 18.3 | 18.71 | 19.25 | 19.68 | 19.97 | 20.05 | 20.05 | 19.89 | 19.38 | 18.66 | 18.02 | (93) |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

## 9. Space heating calculation

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= | 0.96 | 0.94 | 0.91 | 0.85 | 0.76 | 0.59 | 0.41 | 0.45 | 0.67 | 0.85 | 0.93 | 0.96 | (94) |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|

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

|        |        |        |        |        |        |        |        |        |       |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|------|
| (95)m= | 754.63 | 819.13 | 839.79 | 812.79 | 722.73 | 538.48 | 365.23 | 381.42 | 559.9 | 686.22 | 712.42 | 723.75 | (95) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|------|

Monthly average external temperature from Table 8

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

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

|        |         |         |         |        |        |        |        |        |        |        |         |        |      |
|--------|---------|---------|---------|--------|--------|--------|--------|--------|--------|--------|---------|--------|------|
| (97)m= | 1605.85 | 1558.89 | 1411.93 | 1163.7 | 891.74 | 583.28 | 374.39 | 393.51 | 636.48 | 981.16 | 1306.73 | 1581.2 | (97) |
|--------|---------|---------|---------|--------|--------|--------|--------|--------|--------|--------|---------|--------|------|

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

|                                                         |       |        |        |        |        |   |   |   |   |        |       |         |      |
|---------------------------------------------------------|-------|--------|--------|--------|--------|---|---|---|---|--------|-------|---------|------|
| (98)m=                                                  | 633.3 | 497.12 | 425.68 | 252.65 | 125.74 | 0 | 0 | 0 | 0 | 219.43 | 427.9 | 637.94  |      |
| Total per year (kWh/year) = Sum(98) <sub>1...12</sub> = |       |        |        |        |        |   |   |   |   |        |       | 3219.77 | (98) |

Space heating requirement in kWh/m<sup>2</sup>/year

|       |      |
|-------|------|
| 30.04 | (99) |
|-------|------|

## 9a. Energy requirements for individual heating systems including micro-CHP

### Space heating:

|                                                            |                               |      |       |
|------------------------------------------------------------|-------------------------------|------|-------|
| Fraction of space heat from secondary/supplementary system |                               | 0    | (201) |
| Fraction of space heat from main system(s)                 | (202) = 1 – (201) =           | 1    | (202) |
| Fraction of total heating from main system 1               | (204) = (202) × [1 – (203)] = | 1    | (204) |
| Efficiency of main space heating system 1                  |                               | 90.5 | (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)

|       |        |        |        |        |   |   |   |   |        |       |        |
|-------|--------|--------|--------|--------|---|---|---|---|--------|-------|--------|
| 633.3 | 497.12 | 425.68 | 252.65 | 125.74 | 0 | 0 | 0 | 0 | 219.43 | 427.9 | 637.94 |
|-------|--------|--------|--------|--------|---|---|---|---|--------|-------|--------|

(211)m = {[(98)m x (204)] } x 100 ÷ (206)

|                                                |       |        |        |        |   |   |   |   |        |        |        |         |       |
|------------------------------------------------|-------|--------|--------|--------|---|---|---|---|--------|--------|--------|---------|-------|
| 699.78                                         | 549.3 | 470.36 | 279.17 | 138.94 | 0 | 0 | 0 | 0 | 242.47 | 472.82 | 704.91 |         |       |
| Total (kWh/year) =Sum(211) <sub>1...12</sub> = |       |        |        |        |   |   |   |   |        |        |        | 3557.76 | (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 |   |       |
| Total (kWh/year) =Sum(215) <sub>1...12</sub> = |   |   |   |   |   |   |   |   |   |   |   | 0 | (215) |

### Water heating

Output from water heater (calculated above)

|       |        |        |        |        |        |        |        |        |        |        |        |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 178.3 | 156.34 | 162.26 | 142.78 | 137.97 | 120.49 | 113.07 | 127.73 | 128.66 | 148.19 | 160.05 | 173.11 |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

|                            |      |       |
|----------------------------|------|-------|
| Efficiency of water heater | 87.3 | (216) |
|----------------------------|------|-------|

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|         |       |       |       |       |      |      |      |      |      |       |       |      |       |
|---------|-------|-------|-------|-------|------|------|------|------|------|-------|-------|------|-------|
| (217)m= | 89.78 | 89.71 | 89.59 | 89.32 | 88.8 | 87.3 | 87.3 | 87.3 | 87.3 | 89.18 | 89.61 | 89.8 | (217) |
|---------|-------|-------|-------|-------|------|------|------|------|------|-------|-------|------|-------|

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

|                              |       |        |        |        |        |        |        |        |        |        |        |         |       |
|------------------------------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|-------|
| (219)m=                      | 198.6 | 174.26 | 181.11 | 159.85 | 155.38 | 138.02 | 129.52 | 146.31 | 147.38 | 166.16 | 178.62 | 192.78  |       |
| Total = Sum(219a)...(219j) = |       |        |        |        |        |        |        |        |        |        |        | 1967.99 | (219) |

## Annual totals

|                                                                           | kWh/year                 | kWh/year |
|---------------------------------------------------------------------------|--------------------------|----------|
| Space heating fuel used, main system 1                                    |                          | 3557.76  |
| Water heating fuel used                                                   |                          | 1967.99  |
| Electricity for pumps, fans and electric keep-hot                         |                          |          |
| mechanical ventilation - balanced, extract or positive input from outside | 69.35                    | (230a)   |
| central heating pump:                                                     | 30                       | (230c)   |
| boiler with a fan-assisted flue                                           | 45                       | (230e)   |
| Total electricity for the above, kWh/year                                 | sum of (230a)...(230g) = | 144.35   |
| Electricity for lighting                                                  |                          | 472.49   |

## 10a Fuel costs - individual heating systems

|                                                                                                                         | Fuel<br>kWh/year | Fuel Price<br>(Table 12) | Fuel Cost<br>£/year |
|-------------------------------------------------------------------------------------------------------------------------|------------------|--------------------------|---------------------|
| Space heating - main system 1                                                                                           | (211) x          | 3.48                     | 123.81              |
| Space heating - main system 2                                                                                           | (213) x          | 0                        | 0                   |
| Space heating - secondary                                                                                               | (215) x          | 13.19                    | 0                   |
| Water heating cost (other fuel)                                                                                         | (219)            | 3.48                     | 68.49               |
| Pumps, fans and electric keep-hot                                                                                       | (231)            | 13.19                    | 19.04               |
| (if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a |                  |                          |                     |
| Energy for lighting                                                                                                     | (232)            | 13.19                    | 62.32               |
| Additional standing charges (Table 12)                                                                                  |                  |                          | 120                 |

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

|                          |                                 |        |       |
|--------------------------|---------------------------------|--------|-------|
| <b>Total energy cost</b> | (245)...(247) + (250)...(254) = | 393.66 | (255) |
|--------------------------|---------------------------------|--------|-------|

## 11a SAP rating - individual heating systems

|                                 |                                  |       |       |
|---------------------------------|----------------------------------|-------|-------|
| Energy cost deflator (Table 12) |                                  | 0.42  | (256) |
| Energy cost factor (ECF)        | [(255) x (256)] ÷ [(4) + 45.0] = | 1.09  | (257) |
| <b>SAP rating (Section 12)</b>  |                                  | 84.85 | (258) |

## 12a CO2 emissions - individual heating systems including micro-CHP

|                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating (main system 1) | (211) x            | 0.216                         | 768.48                   |
| Space heating (secondary)     | (215) x            | 0.519                         | 0                        |
| Water heating                 | (219) x            | 0.216                         | 425.09                   |

## SAP WorkSheet: New dwelling design stage

|                                                   |                                 |       |   |         |       |
|---------------------------------------------------|---------------------------------|-------|---|---------|-------|
| Space and water heating                           | {261} + {262} + {263} + {264} = |       |   | 1193.56 | {265} |
| Electricity for pumps, fans and electric keep-hot | {231} x                         | 0.519 | = | 74.92   | {267} |
| Electricity for lighting                          | {232} x                         | 0.519 | = | 245.22  | {268} |
| Total CO2, kg/year                                | sum of {265} .. {271} =         |       |   | 1513.7  | {272} |
| <b>CO2 emissions per m²</b>                       | {272} ÷ {4} =                   |       |   | 14.12   | {273} |
| El rating (section 14)                            |                                 |       |   | 87      | {274} |

### 1.3a Primary Energy

|                                                   | Energy<br>kWh/year              | Primary<br>factor |   | P. Energy<br>kWh/year |       |
|---------------------------------------------------|---------------------------------|-------------------|---|-----------------------|-------|
| Space heating (main system 1)                     | {211} x                         | 1.22              | = | 4340.47               | {261} |
| Space heating (secondary)                         | {215} x                         | 3.07              | = | 0                     | {263} |
| Energy for water heating                          | {219} x                         | 1.22              | = | 2400.94               | {264} |
| Space and water heating                           | {261} + {262} + {263} + {264} = |                   |   | 6741.41               | {265} |
| Electricity for pumps, fans and electric keep-hot | {231} x                         | 3.07              | = | 443.15                | {267} |
| Electricity for lighting                          | {232} x                         | 0                 | = | 1450.55               | {268} |
| 'Total Primary Energy                             | sum of {265}...{271} =          |                   |   | 8635.11               | {272} |
| <b>Primary energy kWh/m²/year</b>                 | {272} ÷ {4} =                   |                   |   | 80.55                 | {273} |

# DFEE WorkSheet: New dwelling design stage

## User Details

**Assessor Name:** Gerard Mcguigan **Stroma Number:** STRO011196  
**Software Name:** Stroma FSAP 2012 **Software Version:** Version: 1.0.4.18

## Property Address: Plot 125

**Address :** Plot 125, The Hedgerows, Westergate, PO20

## 1. General dwelling dimensions

|                                                           | Area(m <sup>2</sup> ) |        | Av. Height(m) |                                      | Volume(m <sup>3</sup> ) |
|-----------------------------------------------------------|-----------------------|--------|---------------|--------------------------------------|-------------------------|
| Ground floor                                              | 53.6                  | (1a) x | 2.3           | (2a) =                               | 123.28 (3a)             |
| First floor                                               | 53.6                  | (1b) x | 2.6           | (2b) =                               | 139.36 (3b)             |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 107.2                 | (4)    |               |                                      |                         |
| Dwelling volume                                           |                       |        |               | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 262.64 (5)              |

## 2. Ventilation rate

|                              | main heating |   | secondary heating |   | other |   | total |        | m <sup>3</sup> per hour |
|------------------------------|--------------|---|-------------------|---|-------|---|-------|--------|-------------------------|
| Number of chimneys           | 0            | + | 0                 | + | 0     | = | 0     | x 40 = | 0 (6a)                  |
| Number of open flues         | 0            | + | 0                 | + | 0     | = | 0     | x 20 = | 0 (6b)                  |
| Number of intermittent fans  |              |   |                   |   |       |   | 4     | x 10 = | 40 (7a)                 |
| Number of passive vents      |              |   |                   |   |       |   | 0     | x 10 = | 0 (7b)                  |
| Number of flueless gas fires |              |   |                   |   |       |   | 0     | x 40 = | 0 (7c)                  |

## Air changes per hour

|                                                                                                                                                        |                                          |               |           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------------|-----------|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =                                                                              | 40                                       | ÷ (5) =       | 0.15 (8)  |
| <i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>                              |                                          |               |           |
| 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)    |
| <i>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</i> |                                          |               |           |
| 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                                                      |                                          |               | 7 (17)    |
| If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)                                                               |                                          |               | 0.5 (18)  |
| <i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>                                |                                          |               |           |
| Number of sides sheltered                                                                                                                              |                                          |               | 2 (19)    |
| Shelter factor                                                                                                                                         | (20) = 1 - {0.075 x (19)} =              |               | 0.85 (20) |
| Infiltration rate incorporating shelter factor                                                                                                         | (21) = (18) x (20) =                     |               | 0.43 (21) |
| Infiltration rate modified for monthly wind speed                                                                                                      |                                          |               |           |

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

Monthly average wind speed from Table 7

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

|  |      |      |      |      |      |      |      |      |      |      |      |     |
|--|------|------|------|------|------|------|------|------|------|------|------|-----|
|  | 0.54 | 0.53 | 0.52 | 0.47 | 0.46 | 0.41 | 0.41 | 0.39 | 0.43 | 0.46 | 0.48 | 0.5 |
|--|------|------|------|------|------|------|------|------|------|------|------|-----|

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (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)m x 0.5]

|         |      |      |      |      |      |      |      |      |      |      |      |      |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|
| (24d)m= | 0.65 | 0.64 | 0.64 | 0.61 | 0.61 | 0.58 | 0.58 | 0.58 | 0.59 | 0.61 | 0.62 | 0.63 |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|

(24d)

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

|        |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| (25)m= | 0.65 | 0.64 | 0.64 | 0.61 | 0.61 | 0.58 | 0.58 | 0.58 | 0.59 | 0.61 | 0.62 | 0.63 |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|

(25)

## 3. Heat losses and heat loss parameter

| ELEMENT                                | Gross area (m <sup>2</sup> ) | Openings m <sup>2</sup> | Net Area A ,m <sup>2</sup> | U-value W/m <sup>2</sup> K  | A X U (W/K) | k-value kJ/m <sup>2</sup> ·K | A X k kJ/K   |
|----------------------------------------|------------------------------|-------------------------|----------------------------|-----------------------------|-------------|------------------------------|--------------|
| Doors                                  |                              |                         | 2.1                        | 1.3                         | 2.73        |                              | (26)         |
| Windows Type 1                         |                              |                         | 5.35                       | $\times 1/[1/(1.4) + 0.04]$ | 7.09        |                              | (27)         |
| Windows Type 2                         |                              |                         | 6.9                        | $\times 1/[1/(1.4) + 0.04]$ | 9.15        |                              | (27)         |
| Floor                                  |                              |                         | 53.6                       | 0.15                        | 8.04        | 75                           | 4020 (28)    |
| Walls                                  | 101.67                       | 14.35                   | 87.32                      | 0.25                        | 21.83       | 60                           | 5239.2 (29)  |
| Roof                                   | 53.6                         | 0                       | 53.6                       | 0.11                        | 5.9         | 9                            | 482.4 (30)   |
| Total area of elements, m <sup>2</sup> |                              |                         | 208.87                     |                             |             |                              | (31)         |
| Party wall                             |                              |                         | 45.82                      | 0                           | 0           | 70                           | 3207.4 (32)  |
| Internal wall **                       |                              |                         | 161.3                      |                             |             | 9                            | 1451.7 (32c) |
| Internal floor                         |                              |                         | 53.6                       |                             |             | 18                           | 964.8 (32d)  |
| Internal ceiling                       |                              |                         | 53.6                       |                             |             | 9                            | 482.4 (32e)  |

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[(1/U\text{-value})+0.04]$  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) = 54.74 (33)

Heat capacity Cm = S(A x k) ((23)...(30) + (32) + (32a)...(32e) = 15847.9 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K = (34) ÷ (4) = 147.83 (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.

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

7.68 (36)

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

Total fabric heat loss

(33) + (36) =

62.41 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

|        | Jan   | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| (38)m= | 56.18 | 55.68 | 55.19 | 52.89 | 52.46 | 50.47 | 50.47 | 50.09 | 51.24 | 52.46 | 53.33 | 54.24 |

(38)

Heat transfer coefficient, W/K

(39)m = (37) ÷ (38)m

|        |        |        |       |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| (39)m= | 118.59 | 118.09 | 117.6 | 115.31 | 114.88 | 112.88 | 112.88 | 112.51 | 113.65 | 114.88 | 115.75 | 116.65 |
|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

Average = Sum(39)<sub>1...12</sub> / 12 =

115.3 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

|        |      |     |     |      |      |      |      |      |      |      |      |      |
|--------|------|-----|-----|------|------|------|------|------|------|------|------|------|
| (40)m= | 1.11 | 1.1 | 1.1 | 1.08 | 1.07 | 1.05 | 1.05 | 1.05 | 1.06 | 1.07 | 1.08 | 1.09 |
|--------|------|-----|-----|------|------|------|------|------|------|------|------|------|

Average = Sum(40)<sub>1...12</sub> / 12 =

1.08 (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

2.8

(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

100.63

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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= | 110.69 | 106.66 | 102.64 | 98.61 | 94.59 | 90.56 | 90.56 | 94.59 | 98.61 | 102.64 | 106.66 | 110.69 |
|--------|--------|--------|--------|-------|-------|-------|-------|-------|-------|--------|--------|--------|

Total = Sum(44)<sub>1...12</sub> =

1207.53 (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= | 164.15 | 143.57 | 148.15 | 129.16 | 123.93 | 106.94 | 99.1 | 113.72 | 115.08 | 134.11 | 146.39 | 158.97 |
|--------|--------|--------|--------|--------|--------|--------|------|--------|--------|--------|--------|--------|

Total = Sum(45)<sub>1...12</sub> =

1583.26 (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)

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Energy lost from water storage, kWh/year

$$\{47\} \times \{51\} \times \{52\} \times \{53\} =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$\{56\}m = \{55\} \times \{41\}m$$

(56)m=

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

(56)

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

(57)m=

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

(57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

(59)

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

(61)m=

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

(61)

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

(62)m=

|        |        |        |        |        |      |       |       |       |        |        |        |
|--------|--------|--------|--------|--------|------|-------|-------|-------|--------|--------|--------|
| 139.53 | 122.03 | 125.93 | 109.79 | 105.34 | 90.9 | 84.23 | 96.66 | 97.81 | 113.99 | 124.43 | 135.12 |
|--------|--------|--------|--------|--------|------|-------|-------|-------|--------|--------|--------|

(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=

|        |        |        |        |        |      |       |       |       |        |        |        |
|--------|--------|--------|--------|--------|------|-------|-------|-------|--------|--------|--------|
| 139.53 | 122.03 | 125.93 | 109.79 | 105.34 | 90.9 | 84.23 | 96.66 | 97.81 | 113.99 | 124.43 | 135.12 |
|--------|--------|--------|--------|--------|------|-------|-------|-------|--------|--------|--------|

Output from water heater (annual) × 1.12

1345.77

(64)

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

(65)m=

|       |       |       |       |       |       |       |       |       |      |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|-------|
| 34.88 | 30.51 | 31.48 | 27.45 | 26.34 | 22.73 | 21.06 | 24.16 | 24.45 | 28.5 | 31.11 | 33.78 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|-------|

(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

(66)m=

| Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 |

(66)

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

(67)m=

|       |       |       |       |       |      |      |       |       |      |       |      |
|-------|-------|-------|-------|-------|------|------|-------|-------|------|-------|------|
| 26.75 | 23.76 | 19.33 | 14.63 | 10.94 | 9.23 | 9.98 | 12.97 | 17.41 | 22.1 | 25.79 | 27.5 |
|-------|-------|-------|-------|-------|------|------|-------|-------|------|-------|------|

(67)

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

(68)m=

|        |        |        |        |        |       |       |        |        |        |     |        |
|--------|--------|--------|--------|--------|-------|-------|--------|--------|--------|-----|--------|
| 267.47 | 270.25 | 263.25 | 248.36 | 229.57 | 211.9 | 200.1 | 197.32 | 204.32 | 219.21 | 238 | 255.67 |
|--------|--------|--------|--------|--------|-------|-------|--------|--------|--------|-----|--------|

(68)

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

(69)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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=

|         |         |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

(71)

Water heating gains (Table 5)

(72)m=

|       |      |       |       |      |       |      |       |       |      |       |      |
|-------|------|-------|-------|------|-------|------|-------|-------|------|-------|------|
| 46.88 | 45.4 | 42.31 | 38.12 | 35.4 | 31.56 | 28.3 | 32.48 | 33.96 | 38.3 | 43.21 | 45.4 |
|-------|------|-------|-------|------|-------|------|-------|-------|------|-------|------|

(72)

Total internal gains =

$$\{66\}m + \{67\}m + \{68\}m + \{69\}m + \{70\}m + \{71\}m + \{72\}m$$

(73)m=

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 406.06 | 404.36 | 389.84 | 366.07 | 340.85 | 317.65 | 303.33 | 307.73 | 320.64 | 344.57 | 371.96 | 393.53 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(73)

## 6. Solar gains

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

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| Orientation: | Access Factor<br>Table 6d |      |   | Area<br>m <sup>2</sup> | Flux<br>Table 6a |        |   | g_<br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|--------------|---------------------------|------|---|------------------------|------------------|--------|---|----------------|---|----------------|---|--------------|------|
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 10.63  | x | 0.45           | x | 1.11           | = | 19.71        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 20.32  | x | 0.45           | x | 1.11           | = | 37.67        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 34.53  | x | 0.45           | x | 1.11           | = | 64.01        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 55.46  | x | 0.45           | x | 1.11           | = | 102.82       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 74.72  | x | 0.45           | x | 1.11           | = | 138.51       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 79.99  | x | 0.45           | x | 1.11           | = | 148.27       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 74.68  | x | 0.45           | x | 1.11           | = | 138.43       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 59.25  | x | 0.45           | x | 1.11           | = | 109.83       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 41.52  | x | 0.45           | x | 1.11           | = | 76.96        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 24.19  | x | 0.45           | x | 1.11           | = | 44.84        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 13.12  | x | 0.45           | x | 1.11           | = | 24.32        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x                | 8.86   | x | 0.45           | x | 1.11           | = | 16.43        | (74) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 46.75  | x | 0.45           | x | 1.11           | = | 111.78       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 76.57  | x | 0.45           | x | 1.11           | = | 183.06       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 97.53  | x | 0.45           | x | 1.11           | = | 233.19       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 110.23 | x | 0.45           | x | 1.11           | = | 263.55       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 114.87 | x | 0.45           | x | 1.11           | = | 274.64       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 110.55 | x | 0.45           | x | 1.11           | = | 264.3        | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 108.01 | x | 0.45           | x | 1.11           | = | 258.24       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 104.89 | x | 0.45           | x | 1.11           | = | 250.79       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 101.89 | x | 0.45           | x | 1.11           | = | 243.59       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 82.59  | x | 0.45           | x | 1.11           | = | 197.45       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 55.42  | x | 0.45           | x | 1.11           | = | 132.49       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x                | 40.4   | x | 0.45           | x | 1.11           | = | 96.59        | (78) |

Solar gains in watts, calculated for each month

{83}m = Sum(74)m ... (82)m

|        |        |        |       |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| {83}m= | 131.49 | 220.73 | 297.2 | 366.37 | 413.15 | 412.58 | 396.67 | 360.62 | 320.56 | 242.29 | 156.81 | 113.02 | {83} |
|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

Total gains – internal and solar {84}m = {73}m + {83}m , watts

|        |        |        |        |        |     |        |        |        |       |        |        |        |      |
|--------|--------|--------|--------|--------|-----|--------|--------|--------|-------|--------|--------|--------|------|
| {84}m= | 537.55 | 625.09 | 687.04 | 732.44 | 754 | 730.23 | 700.01 | 668.34 | 641.2 | 586.86 | 528.77 | 506.54 | {84} |
|--------|--------|--------|--------|--------|-----|--------|--------|--------|-------|--------|--------|--------|------|

## 7. Mean internal temperature (heating season)

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

21 {85}

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

|        |      |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|        | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |      |
| {86}m= | 0.99 | 0.99 | 0.97 | 0.95 | 0.89 | 0.78 | 0.63 | 0.67 | 0.85 | 0.96 | 0.99 | 0.99 | {86} |

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

|        |      |       |       |       |       |      |       |       |       |       |       |       |      |
|--------|------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|
| {87}m= | 19.1 | 19.32 | 19.64 | 20.08 | 20.48 | 20.8 | 20.93 | 20.91 | 20.69 | 20.16 | 19.57 | 19.08 | {87} |
|--------|------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|

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

|        |    |    |    |       |       |       |       |       |       |       |       |       |      |
|--------|----|----|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| {88}m= | 20 | 20 | 20 | 20.02 | 20.02 | 20.04 | 20.04 | 20.04 | 20.03 | 20.02 | 20.02 | 20.01 | {88} |
|--------|----|----|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |      |      |      |      |      |      |      |      |     |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|-----|------|------|------|------|
| {89}m= | 0.99 | 0.98 | 0.97 | 0.94 | 0.86 | 0.71 | 0.52 | 0.57 | 0.8 | 0.94 | 0.98 | 0.99 | {89} |
|--------|------|------|------|------|------|------|------|------|-----|------|------|------|------|

## DFEE WorkSheet: New dwelling design stage

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

|                           |       |       |       |       |       |       |       |    |       |       |       |       |      |
|---------------------------|-------|-------|-------|-------|-------|-------|-------|----|-------|-------|-------|-------|------|
| (90)m=                    | 18.26 | 18.47 | 18.79 | 19.23 | 19.62 | 19.91 | 20.01 | 20 | 19.82 | 19.33 | 18.73 | 18.24 | (90) |
| fLA = Living area ÷ (4) = |       |       |       |       |       |       |       |    |       |       |       |       | (91) |
| 0.16                      |       |       |       |       |       |       |       |    |       |       |       |       |      |

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

|        |       |      |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (92)m= | 18.39 | 18.6 | 18.93 | 19.37 | 19.75 | 20.05 | 20.15 | 20.15 | 19.96 | 19.46 | 18.86 | 18.38 | (92) |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |      |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (93)m= | 18.39 | 18.6 | 18.93 | 19.37 | 19.75 | 20.05 | 20.15 | 20.15 | 19.96 | 19.46 | 18.86 | 18.38 | (93) |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

### 5. Space heating requirement

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

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

Utilisation factor for gains, hm:

|        |      |      |      |      |      |      |      |      |     |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|-----|------|------|------|------|
| (94)m= | 0.99 | 0.98 | 0.96 | 0.93 | 0.85 | 0.71 | 0.54 | 0.58 | 0.8 | 0.93 | 0.98 | 0.99 | (94) |
|--------|------|------|------|------|------|------|------|------|-----|------|------|------|------|

Useful gains, hmGm, W = (94)m × (84)m

|        |        |        |        |        |        |        |        |       |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|------|
| (95)m= | 530.42 | 610.95 | 660.11 | 677.76 | 642.83 | 519.45 | 376.24 | 387.9 | 510.48 | 548.63 | 517.19 | 501.03 | (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 × ((93)m – (96)m)]

|        |         |         |         |         |        |       |        |        |       |         |         |         |      |
|--------|---------|---------|---------|---------|--------|-------|--------|--------|-------|---------|---------|---------|------|
| (97)m= | 1670.85 | 1617.95 | 1461.34 | 1206.76 | 925.33 | 615.4 | 401.28 | 421.37 | 665.6 | 1017.56 | 1361.49 | 1653.79 | (97) |
|--------|---------|---------|---------|---------|--------|-------|--------|--------|-------|---------|---------|---------|------|

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

|                                       |        |       |        |        |        |   |   |   |   |        |        |        |      |
|---------------------------------------|--------|-------|--------|--------|--------|---|---|---|---|--------|--------|--------|------|
| (98)m=                                | 848.48 | 676.7 | 596.11 | 380.88 | 210.18 | 0 | 0 | 0 | 0 | 348.89 | 607.89 | 857.65 | (98) |
| Total per year (kWh/year) = Sum(98) = |        |       |        |        |        |   |   |   |   |        |        |        | (99) |
| 4526.79                               |        |       |        |        |        |   |   |   |   |        |        |        |      |

Space heating requirement in kWh/m<sup>2</sup>/year

42.23 (99)

### 6. 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 | 1061.05 | 835.29 | 855.06 | 0 | 0 | 0 | 0 | (100) |
|---------|---|---|---|---|---|---------|--------|--------|---|---|---|---|-------|

Utilisation factor for loss hm

|         |   |   |   |   |   |      |      |     |   |   |   |   |       |
|---------|---|---|---|---|---|------|------|-----|---|---|---|---|-------|
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.74 | 0.82 | 0.8 | 0 | 0 | 0 | 0 | (101) |
|---------|---|---|---|---|---|------|------|-----|---|---|---|---|-------|

Useful loss, hmLm (Watts) = (100)m × (101)m

|         |   |   |   |   |   |        |        |       |   |   |   |   |       |
|---------|---|---|---|---|---|--------|--------|-------|---|---|---|---|-------|
| (102)m= | 0 | 0 | 0 | 0 | 0 | 788.87 | 685.82 | 683.2 | 0 | 0 | 0 | 0 | (102) |
|---------|---|---|---|---|---|--------|--------|-------|---|---|---|---|-------|

Gains (solar gains calculated for applicable weather region, see Table 10)

|         |   |   |   |   |   |        |        |        |   |   |   |   |       |
|---------|---|---|---|---|---|--------|--------|--------|---|---|---|---|-------|
| (103)m= | 0 | 0 | 0 | 0 | 0 | 963.67 | 926.06 | 891.43 | 0 | 0 | 0 | 0 | (103) |
|---------|---|---|---|---|---|--------|--------|--------|---|---|---|---|-------|

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 × [(103)m – (102)m] × (41)m

set (104)m to zero if (104)m < 3 × (98)m

|                    |   |   |   |   |   |        |        |        |   |   |   |   |       |
|--------------------|---|---|---|---|---|--------|--------|--------|---|---|---|---|-------|
| (104)m=            | 0 | 0 | 0 | 0 | 0 | 125.86 | 178.74 | 154.92 | 0 | 0 | 0 | 0 | (104) |
| Total = Sum(104) = |   |   |   |   |   |        |        |        |   |   |   |   | (105) |
| 459.52             |   |   |   |   |   |        |        |        |   |   |   |   |       |

Cooled fraction

f C = cooled area ÷ (4) =

1 (105)

Intermittency factor (Table 10b)

|                    |   |   |   |   |   |      |      |      |   |   |   |   |       |
|--------------------|---|---|---|---|---|------|------|------|---|---|---|---|-------|
| (105)m=            | 0 | 0 | 0 | 0 | 0 | 0.25 | 0.25 | 0.25 | 0 | 0 | 0 | 0 | (106) |
| Total = Sum(105) = |   |   |   |   |   |      |      |      |   |   |   |   | (107) |
| 0                  |   |   |   |   |   |      |      |      |   |   |   |   |       |

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

|                    |   |   |   |   |   |       |       |       |   |   |   |   |       |
|--------------------|---|---|---|---|---|-------|-------|-------|---|---|---|---|-------|
| (107)m=            | 0 | 0 | 0 | 0 | 0 | 31.46 | 44.69 | 38.73 | 0 | 0 | 0 | 0 | (107) |
| Total = Sum(107) = |   |   |   |   |   |       |       |       |   |   |   |   |       |
| 114.88             |   |   |   |   |   |       |       |       |   |   |   |   |       |

## DFEE WorkSheet: New dwelling design stage

|                                                                                        |                |                 |       |
|----------------------------------------------------------------------------------------|----------------|-----------------|-------|
| Space cooling requirement in kWh/m <sup>2</sup> /year                                  | (107) ÷ (4) =  | <div>1.07</div> | (108) |
| 91 Fabric Energy Efficiency, calculated only under special conditions, see section 1.5 |                |                 |       |
| Fabric Energy Efficiency                                                               | (99) + (108) = | <div>43.3</div> | (109) |

# DER WorkSheet: New dwelling design stage

## User Details

**Assessor Name:** Gerard Mcguigan **Stroma Number:** STRO011196  
**Software Name:** Stroma FSAP 2012 **Software Version:** Version: 1.0.4.18

## Property Address: Plot 125

**Address :** Plot 125, The Hedgerows, Westergate, PO20

## 1. General dwelling dimensions

|                                                           | Area(m <sup>2</sup> ) |        | Av. Height(m) |                                      | Volume(m <sup>3</sup> ) |
|-----------------------------------------------------------|-----------------------|--------|---------------|--------------------------------------|-------------------------|
| Ground floor                                              | 53.6                  | (1a) x | 2.3           | (2a) =                               | 123.28 (3a)             |
| First floor                                               | 53.6                  | (1b) x | 2.6           | (2b) =                               | 139.36 (3b)             |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 107.2                 | (4)    |               |                                      |                         |
| Dwelling volume                                           |                       |        |               | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 262.64 (5)              |

## 2. Ventilation rate

|                              | main heating |   | secondary heating |   | other |   | total |        | m <sup>3</sup> 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)     |
| <i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>                              |                                          |               |           |
| 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)    |
| <i>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</i> |                                          |               |           |
| 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                                                      |                                          |               | 7 (17)    |
| If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)                                                               |                                          |               | 0.35 (18) |
| <i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>                                |                                          |               |           |
| Number of sides sheltered                                                                                                                              |                                          |               | 2 (19)    |
| Shelter factor                                                                                                                                         | (20) = 1 - {0.075 x (19)} =              |               | 0.85 (20) |
| Infiltration rate incorporating shelter factor                                                                                                         | (21) = (18) x (20) =                     |               | 0.3 (21)  |
| Infiltration rate modified for monthly wind speed                                                                                                      |                                          |               |           |

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

Monthly average wind speed from Table 7

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

# DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

|  |      |      |      |      |      |      |      |      |     |      |      |      |
|--|------|------|------|------|------|------|------|------|-----|------|------|------|
|  | 0.38 | 0.37 | 0.36 | 0.33 | 0.32 | 0.28 | 0.28 | 0.28 | 0.3 | 0.32 | 0.33 | 0.35 |
|--|------|------|------|------|------|------|------|------|-----|------|------|------|

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a) 0.5

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

(23b) 0.5

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

(23c) 0

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

|         |      |      |      |      |      |      |      |      |      |      |      |     |
|---------|------|------|------|------|------|------|------|------|------|------|------|-----|
| (24c)m= | 0.63 | 0.62 | 0.61 | 0.58 | 0.57 | 0.53 | 0.53 | 0.53 | 0.55 | 0.57 | 0.58 | 0.6 |
|---------|------|------|------|------|------|------|------|------|------|------|------|-----|

(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)m 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= | 0.63 | 0.62 | 0.61 | 0.58 | 0.57 | 0.53 | 0.53 | 0.53 | 0.55 | 0.57 | 0.58 | 0.6 |
|--------|------|------|------|------|------|------|------|------|------|------|------|-----|

(25)

## 3. Heat losses and heat loss parameter

| ELEMENT                                | Gross area (m <sup>2</sup> ) | Openings m <sup>2</sup> | Net Area A ,m <sup>2</sup> | U-value W/m <sup>2</sup> K  | A X U (W/K) | k-value kJ/m <sup>2</sup> ·K | A X k kJ/K   |
|----------------------------------------|------------------------------|-------------------------|----------------------------|-----------------------------|-------------|------------------------------|--------------|
| Doors                                  |                              |                         | 2.1                        | 1.3                         | 2.73        |                              | (26)         |
| Windows Type 1                         |                              |                         | 5.35                       | $\times 1/[1/(1.4) + 0.04]$ | 7.09        |                              | (27)         |
| Windows Type 2                         |                              |                         | 6.9                        | $\times 1/[1/(1.4) + 0.04]$ | 9.15        |                              | (27)         |
| Floor                                  |                              |                         | 53.6                       | 0.15                        | 8.04        | 75                           | 4020 (28)    |
| Walls                                  | 101.67                       | 14.35                   | 87.32                      | 0.25                        | 21.83       | 60                           | 5239.2 (29)  |
| Roof                                   | 53.6                         | 0                       | 53.6                       | 0.11                        | 5.9         | 9                            | 482.4 (30)   |
| Total area of elements, m <sup>2</sup> |                              |                         | 208.87                     |                             |             |                              | (31)         |
| Party wall                             |                              |                         | 45.82                      | 0                           | 0           | 70                           | 3207.4 (32)  |
| Internal wall **                       |                              |                         | 161.3                      |                             |             | 9                            | 1451.7 (32c) |
| Internal floor                         |                              |                         | 53.6                       |                             |             | 18                           | 964.8 (32d)  |
| Internal ceiling                       |                              |                         | 53.6                       |                             |             | 9                            | 482.4 (32e)  |

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[(1/U\text{-value})+0.04]$  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) = 54.74 (33)

Heat capacity Cm = S(A x k) ((23) ... (30) + (32) + (32a) ... (32e) = 15847.9 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K = (34) ÷ (4) = 147.83 (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.

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

7.68 (36)

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

Total fabric heat loss

(33) + (36) =

62.41 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

|        | Jan   | Feb  | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| (38)m= | 54.54 | 53.9 | 53.25 | 50.03 | 49.39 | 46.16 | 46.16 | 45.52 | 47.45 | 49.39 | 50.68 | 51.96 |

(38)

Heat transfer coefficient, W/K

(39)m = (37) ÷ (38)m

|        |        |        |        |        |       |        |        |        |        |       |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|-------|--------|--------|
| (39)m= | 116.96 | 116.31 | 115.67 | 112.44 | 111.8 | 108.58 | 108.58 | 107.93 | 109.87 | 111.8 | 113.09 | 114.38 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|-------|--------|--------|

Average = Sum(39)<sub>1...12</sub> / 12 =

112.28 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

|        |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| (40)m= | 1.09 | 1.08 | 1.08 | 1.05 | 1.04 | 1.01 | 1.01 | 1.01 | 1.02 | 1.04 | 1.05 | 1.07 |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|

Average = Sum(40)<sub>1...12</sub> / 12 =

1.05 (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

2.8

(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

100.63

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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= | 110.69 | 106.66 | 102.64 | 98.61 | 94.59 | 90.56 | 90.56 | 94.59 | 98.61 | 102.64 | 106.66 | 110.69 |
|--------|--------|--------|--------|-------|-------|-------|-------|-------|-------|--------|--------|--------|

Total = Sum(44)<sub>1...12</sub> =

1207.53 (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= | 164.15 | 143.57 | 148.15 | 129.16 | 123.93 | 106.94 | 99.1 | 113.72 | 115.08 | 134.11 | 146.39 | 158.97 |
|--------|--------|--------|--------|--------|--------|--------|------|--------|--------|--------|--------|--------|

Total = Sum(45)<sub>1...12</sub> =

1583.26 (45)

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| (46)m= | 24.62 | 21.53 | 22.22 | 19.37 | 18.59 | 16.04 | 14.86 | 17.06 | 17.26 | 20.12 | 21.96 | 23.85 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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)

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Energy lost from water storage, kWh/year

$$\{47\} \times \{51\} \times \{52\} \times \{53\} =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$\{56\}m = \{55\} \times \{41\}m$$

(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 × [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

(57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

(59)

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

(61)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 14.15 | 12.77 | 14.11 | 13.62 | 14.04 | 13.55 | 13.97 | 14.01 | 13.59 | 14.08 | 13.66 | 14.14 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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=

|       |        |        |        |        |        |        |        |        |        |        |        |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 178.3 | 156.34 | 162.26 | 142.78 | 137.97 | 120.49 | 113.07 | 127.73 | 128.66 | 148.19 | 160.05 | 173.11 |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(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=

|       |        |        |        |        |        |        |        |        |        |        |        |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 178.3 | 156.34 | 162.26 | 142.78 | 137.97 | 120.49 | 113.07 | 127.73 | 128.66 | 148.19 | 160.05 | 173.11 |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

Output from water heater (annual) × 1.12

1748.94

(64)

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 58.12 | 50.93 | 52.79 | 46.35 | 44.72 | 38.94 | 36.44 | 41.31 | 41.66 | 48.11 | 52.09 | 56.39 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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

(66)m=

| Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 |

(66)

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

(67)m=

|       |       |       |       |       |      |      |       |       |      |       |      |
|-------|-------|-------|-------|-------|------|------|-------|-------|------|-------|------|
| 26.75 | 23.76 | 19.33 | 14.63 | 10.94 | 9.23 | 9.98 | 12.97 | 17.41 | 22.1 | 25.79 | 27.5 |
|-------|-------|-------|-------|-------|------|------|-------|-------|------|-------|------|

(67)

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

(68)m=

|        |        |        |        |        |       |       |        |        |        |     |        |
|--------|--------|--------|--------|--------|-------|-------|--------|--------|--------|-----|--------|
| 267.47 | 270.25 | 263.25 | 248.36 | 229.57 | 211.9 | 200.1 | 197.32 | 204.32 | 219.21 | 238 | 255.67 |
|--------|--------|--------|--------|--------|-------|-------|--------|--------|--------|-----|--------|

(68)

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

(69)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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=

|         |         |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

(71)

Water heating gains (Table 5)

(72)m=

|       |       |       |       |      |       |       |       |       |       |       |      |
|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|
| 78.11 | 75.79 | 70.95 | 64.37 | 60.1 | 54.09 | 48.98 | 55.53 | 57.86 | 64.67 | 72.35 | 75.8 |
|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|

(72)

Total internal gains =

$$\{66\}m + \{67\}m + \{68\}m + \{69\}m + \{70\}m + \{71\}m + \{72\}m$$

(73)m=

|        |        |        |        |        |        |        |        |        |        |       |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|
| 440.29 | 437.75 | 421.48 | 395.32 | 368.56 | 343.18 | 327.01 | 333.78 | 347.54 | 373.93 | 404.1 | 426.92 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|

(73)

### 6. Solar gains

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

# DER WorkSheet: New dwelling design stage

| Orientation: | Access Factor<br>Table 6d |      |   | Area<br>m <sup>2</sup> |   | Flux<br>Table 6a |   | g_<br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|--------------|---------------------------|------|---|------------------------|---|------------------|---|----------------|---|----------------|---|--------------|------|
| North        | 0.9x                      | 0.77 | x | 5.35                   | x | 10.63            | x | 0.45           | x | 1.11           | = | 19.71        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x | 20.32            | x | 0.45           | x | 1.11           | = | 37.67        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x | 34.53            | x | 0.45           | x | 1.11           | = | 64.01        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x | 55.46            | x | 0.45           | x | 1.11           | = | 102.82       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x | 74.72            | x | 0.45           | x | 1.11           | = | 138.51       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x | 79.99            | x | 0.45           | x | 1.11           | = | 148.27       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x | 74.68            | x | 0.45           | x | 1.11           | = | 138.43       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x | 59.25            | x | 0.45           | x | 1.11           | = | 109.83       | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x | 41.52            | x | 0.45           | x | 1.11           | = | 76.96        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x | 24.19            | x | 0.45           | x | 1.11           | = | 44.84        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x | 13.12            | x | 0.45           | x | 1.11           | = | 24.32        | (74) |
| North        | 0.9x                      | 0.77 | x | 5.35                   | x | 8.86             | x | 0.45           | x | 1.11           | = | 16.43        | (74) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x | 46.75            | x | 0.45           | x | 1.11           | = | 111.78       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x | 76.57            | x | 0.45           | x | 1.11           | = | 183.06       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x | 97.53            | x | 0.45           | x | 1.11           | = | 233.19       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x | 110.23           | x | 0.45           | x | 1.11           | = | 263.55       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x | 114.87           | x | 0.45           | x | 1.11           | = | 274.64       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x | 110.55           | x | 0.45           | x | 1.11           | = | 264.3        | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x | 108.01           | x | 0.45           | x | 1.11           | = | 258.24       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x | 104.89           | x | 0.45           | x | 1.11           | = | 250.79       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x | 101.89           | x | 0.45           | x | 1.11           | = | 243.59       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x | 82.59            | x | 0.45           | x | 1.11           | = | 197.45       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x | 55.42            | x | 0.45           | x | 1.11           | = | 132.49       | (78) |
| South        | 0.9x                      | 0.77 | x | 6.9                    | x | 40.4             | x | 0.45           | x | 1.11           | = | 96.59        | (78) |

Solar gains in watts, calculated for each month

{83}m = Sum{74}m ... {82}m

|        |        |        |       |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| {83}m= | 131.49 | 220.73 | 297.2 | 366.37 | 413.15 | 412.58 | 396.67 | 360.62 | 320.56 | 242.29 | 156.81 | 113.02 | {83} |
|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

Total gains – internal and solar {84}m = {73}m + {83}m , watts

|        |        |        |        |        |       |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|------|
| {84}m= | 571.78 | 658.48 | 718.68 | 761.69 | 781.7 | 755.76 | 723.69 | 694.39 | 668.09 | 616.22 | 560.91 | 539.94 | {84} |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|------|

## 7. Mean internal temperature (heating season)

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

21 {85}

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

|        |      |      |      |      |      |      |     |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|-----|------|------|------|------|------|------|
|        | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul | Aug  | Sep  | Oct  | Nov  | Dec  |      |
| {86}m= | 0.99 | 0.98 | 0.97 | 0.94 | 0.88 | 0.75 | 0.6 | 0.64 | 0.83 | 0.95 | 0.98 | 0.99 | {86} |

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| {87}m= | 19.18 | 19.39 | 19.71 | 20.14 | 20.53 | 20.83 | 20.95 | 20.93 | 20.73 | 20.23 | 19.65 | 19.17 | {87} |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| {88}m= | 20.01 | 20.01 | 20.02 | 20.04 | 20.05 | 20.07 | 20.07 | 20.08 | 20.06 | 20.05 | 20.04 | 20.03 | {88} |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |      |      |      |      |      |      |     |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|-----|------|------|------|------|------|------|
| {89}m= | 0.99 | 0.98 | 0.96 | 0.93 | 0.85 | 0.68 | 0.5 | 0.54 | 0.78 | 0.94 | 0.98 | 0.99 | {89} |
|--------|------|------|------|------|------|------|-----|------|------|------|------|------|------|

# DER WorkSheet: New dwelling design stage

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

|                           |       |       |       |       |       |       |       |       |      |       |       |       |      |
|---------------------------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|------|
| (90)m=                    | 17.56 | 17.87 | 18.34 | 18.98 | 19.52 | 19.92 | 20.04 | 20.03 | 19.8 | 19.11 | 18.26 | 17.55 | (90) |
| fLA = Living area ÷ (4) = |       |       |       |       |       |       |       |       |      |       |       |       | (91) |
|                           |       |       |       |       |       |       |       |       |      |       | 0.16  |       |      |

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (92)m= | 17.81 | 18.11 | 18.55 | 19.16 | 19.68 | 20.06 | 20.18 | 20.17 | 19.94 | 19.29 | 18.48 | 17.81 | (92) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |      |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (93)m= | 17.66 | 17.96 | 18.4 | 19.01 | 19.53 | 19.91 | 20.03 | 20.02 | 19.79 | 19.14 | 18.33 | 17.66 | (93) |
|--------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

## 9. Space heating calculation

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= | 0.98 | 0.97 | 0.95 | 0.91 | 0.83 | 0.67 | 0.49 | 0.53 | 0.76 | 0.92 | 0.97 | 0.98 | (94) |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|

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

|        |        |        |        |        |        |        |        |        |        |        |        |       |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|------|
| (95)m= | 561.03 | 638.39 | 682.31 | 691.41 | 645.47 | 507.14 | 356.46 | 369.51 | 507.34 | 564.71 | 543.92 | 531.5 | (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= | 1562.92 | 1518.61 | 1376.68 | 1137.04 | 875.21 | 577.04 | 372.65 | 391.17 | 625.61 | 954.53 | 1269.9 | 1539.38 | (97) |
|--------|---------|---------|---------|---------|--------|--------|--------|--------|--------|--------|--------|---------|------|

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

|                                                         |        |        |        |        |        |   |   |   |   |        |        |        |      |
|---------------------------------------------------------|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|------|
| (98)m=                                                  | 745.41 | 591.51 | 516.61 | 320.85 | 170.93 | 0 | 0 | 0 | 0 | 290.02 | 522.71 | 749.86 | (98) |
| Total per year (kWh/year) = Sum(98) <sub>1...12</sub> = |        |        |        |        |        |   |   |   |   |        |        |        | (99) |
|                                                         |        |        |        |        |        |   |   |   |   |        | 3907.9 |        |      |

Space heating requirement in kWh/m<sup>2</sup>/year

36.45 (99)

## 9a. Energy requirements for individual heating systems including micro-CHP

### Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = 1 – (201) =

1 (202)

Fraction of total heating from main system 1

(204) = (202) × [1 – (203)] =

1 (204)

Efficiency of main space heating system 1

90.5 (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)

|        |        |        |        |        |   |   |   |   |        |        |        |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|
| 745.41 | 591.51 | 516.61 | 320.85 | 170.93 | 0 | 0 | 0 | 0 | 290.02 | 522.71 | 749.86 |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

|        |       |        |        |        |   |   |   |   |        |        |        |
|--------|-------|--------|--------|--------|---|---|---|---|--------|--------|--------|
| 823.65 | 653.6 | 570.84 | 354.53 | 188.87 | 0 | 0 | 0 | 0 | 320.47 | 577.58 | 828.58 |
|--------|-------|--------|--------|--------|---|---|---|---|--------|--------|--------|

Total (kWh/year) = Sum(211)<sub>1...12</sub> = 4318.12 (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 |   |       |
| Total (kWh/year) =Sum(215) <sub>1...12</sub> = |   |   |   |   |   |   |   |   |   |   |   | 0 | (215) |

### Water heating

Output from water heater (calculated above)

|       |        |        |        |        |        |        |        |        |        |        |        |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 178.3 | 156.34 | 162.26 | 142.78 | 137.97 | 120.49 | 113.07 | 127.73 | 128.66 | 148.19 | 160.05 | 173.11 |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

Efficiency of water heater 87.3 (216)

## DER WorkSheet: New dwelling design stage

|         |       |       |       |       |       |      |      |      |      |       |       |       |       |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|
| {217}m= | 89.86 | 89.81 | 89.71 | 89.49 | 89.04 | 87.3 | 87.3 | 87.3 | 87.3 | 89.39 | 89.73 | 89.88 | {217} |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

|                                         |        |        |        |        |        |        |        |        |        |        |        |         |       |
|-----------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|-------|
| {219}m=                                 | 198.41 | 174.07 | 180.86 | 159.55 | 154.95 | 138.02 | 129.52 | 146.31 | 147.38 | 165.77 | 178.38 | 192.6   |       |
| Total = Sum({219a}) <sub>i=1,12</sub> = |        |        |        |        |        |        |        |        |        |        |        | 1965.81 | {219} |

### Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

69.35 {230a}

central heating pump:

30 {230c}

boiler with a fan-assisted flue

45 {230e}

Total electricity for the above, kWh/year

sum of {230a}...{230g} = 144.35 {231}

Electricity for lighting

472.49 {232}

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

|                                                   | Energy<br>kWh/year              | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------|---------------------------------|-------------------------------|--------------------------|
| Space heating (main system 1)                     | {211} x                         | 0.216                         | 932.71 {261}             |
| Space heating (secondary)                         | {215} x                         | 0.519                         | 0 {263}                  |
| Water heating                                     | {219} x                         | 0.216                         | 424.61 {264}             |
| Space and water heating                           | {261} + {262} + {263} + {264} = |                               | 1357.33 {265}            |
| Electricity for pumps, fans and electric keep-hot | {231} x                         | 0.519                         | 74.92 {267}              |
| Electricity for lighting                          | {232} x                         | 0.519                         | 245.22 {268}             |
| Total CO2, kg/year                                |                                 | sum of {265}...{271} =        | 1677.47 {272}            |
| <b>Dwelling CO2 Emission Rate</b>                 |                                 | {272} ÷ (4) =                 | 15.65 {273}              |
| El rating (section 14)                            |                                 |                               | 85 {274}                 |

# TER WorkSheet: New dwelling design stage

## User Details

**Assessor Name:** Gerard Mcguigan **Stroma Number:** STRO011196  
**Software Name:** Stroma FSAP 2012 **Software Version:** Version: 1.0.4.18

## Property Address: Plot 125

**Address :** Plot 125, The Hedgerows, Westergate, PO20

## 1. General dwelling dimensions

|                                                           | Area(m <sup>2</sup> ) |        | Av. Height(m) |                                      | Volume(m <sup>3</sup> ) |
|-----------------------------------------------------------|-----------------------|--------|---------------|--------------------------------------|-------------------------|
| Ground floor                                              | 53.6                  | (1a) x | 2.3           | (2a) =                               | 123.28 (3a)             |
| First floor                                               | 53.6                  | (1b) x | 2.6           | (2b) =                               | 139.36 (3b)             |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 107.2                 | (4)    |               |                                      |                         |
| Dwelling volume                                           |                       |        |               | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 262.64 (5)              |

## 2. Ventilation rate

|                              | main heating |   | secondary heating |   | other |   | total |        | m <sup>3</sup> per hour |
|------------------------------|--------------|---|-------------------|---|-------|---|-------|--------|-------------------------|
| Number of chimneys           | 0            | + | 0                 | + | 0     | = | 0     | x 40 = | 0 (6a)                  |
| Number of open flues         | 0            | + | 0                 | + | 0     | = | 0     | x 20 = | 0 (6b)                  |
| Number of intermittent fans  |              |   |                   |   |       |   | 4     | x 10 = | 40 (7a)                 |
| Number of passive vents      |              |   |                   |   |       |   | 0     | x 10 = | 0 (7b)                  |
| Number of flueless gas fires |              |   |                   |   |       |   | 0     | x 40 = | 0 (7c)                  |

## Air changes per hour

|                                                                                                                                                        |                                          |               |           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------------|-----------|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =                                                                              | 40                                       | ÷ (5) =       | 0.15 (8)  |
| <i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>                              |                                          |               |           |
| 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)    |
| <i>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</i> |                                          |               |           |
| 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)                                                               |                                          |               | 0.4 (18)  |
| <i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>                                |                                          |               |           |
| Number of sides sheltered                                                                                                                              |                                          |               | 2 (19)    |
| Shelter factor                                                                                                                                         | (20) = 1 - {0.075 x (19)} =              |               | 0.85 (20) |
| Infiltration rate incorporating shelter factor                                                                                                         | (21) = (18) x (20) =                     |               | 0.34 (21) |
| Infiltration rate modified for monthly wind speed                                                                                                      |                                          |               |           |

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

Monthly average wind speed from Table 7

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

# TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

|  |      |      |      |      |      |      |      |      |      |      |      |     |
|--|------|------|------|------|------|------|------|------|------|------|------|-----|
|  | 0.44 | 0.43 | 0.42 | 0.38 | 0.37 | 0.32 | 0.32 | 0.32 | 0.34 | 0.37 | 0.38 | 0.4 |
|--|------|------|------|------|------|------|------|------|------|------|------|-----|

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (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)m x 0.5]

|         |     |      |      |      |      |      |      |      |      |      |      |      |
|---------|-----|------|------|------|------|------|------|------|------|------|------|------|
| (24d)m= | 0.6 | 0.59 | 0.59 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | 0.58 |
|---------|-----|------|------|------|------|------|------|------|------|------|------|------|

(24d)

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

|        |     |      |      |      |      |      |      |      |      |      |      |      |
|--------|-----|------|------|------|------|------|------|------|------|------|------|------|
| (25)m= | 0.6 | 0.59 | 0.59 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | 0.58 |
|--------|-----|------|------|------|------|------|------|------|------|------|------|------|

(25)

## 3. Thermal losses and heat capacity 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                      |                 |             | 2.1            | x 1                  | = 2.1       |                 | (26)       |
| Windows Type 1             |                 |             | 5.35           | x 1/[1/(1.4) + 0.04] | = 7.09      |                 | (27)       |
| Windows Type 2             |                 |             | 6.9            | x 1/[1/(1.4) + 0.04] | = 9.15      |                 | (27)       |
| Floor                      |                 |             | 53.6           | x 0.13               | = 6.967999  |                 | (28)       |
| Walls                      | 101.67          | 14.35       | 87.32          | x 0.18               | = 15.72     |                 | (29)       |
| Roof                       | 53.6            | 0           | 53.6           | x 0.13               | = 6.97      |                 | (30)       |
| Total area of elements, m² |                 |             | 208.87         |                      |             |                 | (31)       |
| Party wall                 |                 |             | 45.82          | x 0                  | = 0         |                 | (32)       |
| Internal wall **           |                 |             | 161.3          |                      |             |                 | (32c)      |
| Internal floor             |                 |             | 53.6           |                      |             |                 | (32d)      |
| Internal ceiling           |                 |             | 53.6           |                      |             |                 | (32e)      |

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

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

Fabric heat loss, W/K = S (A x U) (26) ... (30) + (32) = 47.99 (33)

Heat capacity Cm = S(A x k) ((23) ... (30) + (32) + (32a) ... (32e) = 15847.9 (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.

# TER WorkSheet: New dwelling design stage

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

9.97 (36)

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

Total fabric heat loss

(33) + (36) =

57.96 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

|        | Jan   | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep  | Oct   | Nov   | Dec   |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|
| (38)m= | 51.57 | 51.25 | 50.94 | 49.47 | 49.19 | 47.91 | 47.91 | 47.67 | 48.4 | 49.19 | 49.75 | 50.33 |

(38)

Heat transfer coefficient, W/K

(39)m = (37) ÷ (38)m

|        |        |        |       |        |        |        |        |        |        |        |        |       |
|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| (39)m= | 109.54 | 109.22 | 108.9 | 107.43 | 107.16 | 105.87 | 105.87 | 105.64 | 106.37 | 107.16 | 107.71 | 108.3 |
|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|-------|

Average = Sum(39)<sub>1...12</sub> / 12 =

107.43 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

|        |      |      |      |   |   |      |      |      |      |   |   |      |
|--------|------|------|------|---|---|------|------|------|------|---|---|------|
| (40)m= | 1.02 | 1.02 | 1.02 | 1 | 1 | 0.99 | 0.99 | 0.99 | 0.99 | 1 | 1 | 1.01 |
|--------|------|------|------|---|---|------|------|------|------|---|---|------|

Average = Sum(40)<sub>1...12</sub> / 12 =

1 (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

2.8

(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

100.63

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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= | 110.69 | 106.66 | 102.64 | 98.61 | 94.59 | 90.56 | 90.56 | 94.59 | 98.61 | 102.64 | 106.66 | 110.69 |
|--------|--------|--------|--------|-------|-------|-------|-------|-------|-------|--------|--------|--------|

Total = Sum(44)<sub>1...12</sub> =

1207.53 (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= | 164.15 | 143.57 | 148.15 | 129.16 | 123.93 | 106.94 | 99.1 | 113.72 | 115.08 | 134.11 | 146.39 | 158.97 |
|--------|--------|--------|--------|--------|--------|--------|------|--------|--------|--------|--------|--------|

Total = Sum(45)<sub>1...12</sub> =

1583.26 (45)

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| (46)m= | 24.62 | 21.53 | 22.22 | 19.37 | 18.59 | 16.04 | 14.86 | 17.06 | 17.26 | 20.12 | 21.96 | 23.85 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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)

## TER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year

$$\{47\} \times \{51\} \times \{52\} \times \{53\} =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$\{56\}m = \{55\} \times \{41\}m$$

(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 × [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

(57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

(59)

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

(61)m=

|       |       |       |       |      |       |       |      |       |       |       |       |
|-------|-------|-------|-------|------|-------|-------|------|-------|-------|-------|-------|
| 50.96 | 46.03 | 50.96 | 48.63 | 48.2 | 44.66 | 46.15 | 48.2 | 48.63 | 50.96 | 49.32 | 50.96 |
|-------|-------|-------|-------|------|-------|-------|------|-------|-------|-------|-------|

(61)

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

(62)m=

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 215.11 | 189.59 | 199.11 | 177.79 | 172.13 | 151.6 | 145.25 | 161.92 | 163.71 | 185.07 | 195.71 | 209.93 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

(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=

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 215.11 | 189.59 | 199.11 | 177.79 | 172.13 | 151.6 | 145.25 | 161.92 | 163.71 | 185.07 | 195.71 | 209.93 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

Output from water heater (annual) × 1.12

2166.91

(64)

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

|       |       |    |      |       |       |       |       |       |       |    |      |
|-------|-------|----|------|-------|-------|-------|-------|-------|-------|----|------|
| 67.32 | 59.24 | 62 | 55.1 | 53.26 | 46.72 | 44.49 | 49.86 | 50.42 | 57.33 | 61 | 65.6 |
|-------|-------|----|------|-------|-------|-------|-------|-------|-------|----|------|

(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

(66)m=

| Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 | 139.85 |

(66)

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

(67)m=

|       |       |       |       |       |      |      |       |       |      |       |      |
|-------|-------|-------|-------|-------|------|------|-------|-------|------|-------|------|
| 26.75 | 23.76 | 19.33 | 14.63 | 10.94 | 9.23 | 9.98 | 12.97 | 17.41 | 22.1 | 25.79 | 27.5 |
|-------|-------|-------|-------|-------|------|------|-------|-------|------|-------|------|

(67)

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

(68)m=

|        |        |        |        |        |       |       |        |        |        |     |        |
|--------|--------|--------|--------|--------|-------|-------|--------|--------|--------|-----|--------|
| 267.47 | 270.25 | 263.25 | 248.36 | 229.57 | 211.9 | 200.1 | 197.32 | 204.32 | 219.21 | 238 | 255.67 |
|--------|--------|--------|--------|--------|-------|-------|--------|--------|--------|-----|--------|

(68)

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

(69)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 | 36.98 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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=

|         |         |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 | -111.88 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

(71)

Water heating gains (Table 5)

(72)m=

|       |       |       |       |       |       |      |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|
| 90.48 | 88.16 | 83.33 | 76.53 | 71.58 | 64.89 | 59.8 | 67.02 | 70.03 | 77.06 | 84.73 | 88.17 |
|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|

(72)

Total internal gains =

$$\{66\}m + \{67\}m + \{68\}m + \{69\}m + \{70\}m + \{71\}m + \{72\}m$$

(73)m=

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 452.66 | 450.12 | 433.86 | 407.48 | 380.04 | 353.98 | 337.83 | 345.26 | 359.71 | 386.32 | 416.48 | 439.29 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(73)

### 6. Solar gains

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

# TER WorkSheet: New dwelling design stage

| Orientation: |      | Access Factor<br>Table 6d |   | Area<br>m <sup>2</sup> |   | Flux<br>Table 6a |   | g_<br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|--------------|------|---------------------------|---|------------------------|---|------------------|---|----------------|---|----------------|---|--------------|------|
| North        | 0.9x | 0.77                      | x | 5.35                   | x | 10.63            | x | 0.63           | x | 0.7            | = | 17.39        | {74} |
| North        | 0.9x | 0.77                      | x | 5.35                   | x | 20.32            | x | 0.63           | x | 0.7            | = | 33.23        | {74} |
| North        | 0.9x | 0.77                      | x | 5.35                   | x | 34.53            | x | 0.63           | x | 0.7            | = | 56.46        | {74} |
| North        | 0.9x | 0.77                      | x | 5.35                   | x | 55.46            | x | 0.63           | x | 0.7            | = | 90.69        | {74} |
| North        | 0.9x | 0.77                      | x | 5.35                   | x | 74.72            | x | 0.63           | x | 0.7            | = | 122.16       | {74} |
| North        | 0.9x | 0.77                      | x | 5.35                   | x | 79.99            | x | 0.63           | x | 0.7            | = | 130.78       | {74} |
| North        | 0.9x | 0.77                      | x | 5.35                   | x | 74.68            | x | 0.63           | x | 0.7            | = | 122.1        | {74} |
| North        | 0.9x | 0.77                      | x | 5.35                   | x | 59.25            | x | 0.63           | x | 0.7            | = | 96.87        | {74} |
| North        | 0.9x | 0.77                      | x | 5.35                   | x | 41.52            | x | 0.63           | x | 0.7            | = | 67.88        | {74} |
| North        | 0.9x | 0.77                      | x | 5.35                   | x | 24.19            | x | 0.63           | x | 0.7            | = | 39.55        | {74} |
| North        | 0.9x | 0.77                      | x | 5.35                   | x | 13.12            | x | 0.63           | x | 0.7            | = | 21.45        | {74} |
| North        | 0.9x | 0.77                      | x | 5.35                   | x | 8.86             | x | 0.63           | x | 0.7            | = | 14.49        | {74} |
| South        | 0.9x | 0.77                      | x | 6.9                    | x | 46.75            | x | 0.63           | x | 0.7            | = | 98.59        | {78} |
| South        | 0.9x | 0.77                      | x | 6.9                    | x | 76.57            | x | 0.63           | x | 0.7            | = | 161.46       | {78} |
| South        | 0.9x | 0.77                      | x | 6.9                    | x | 97.53            | x | 0.63           | x | 0.7            | = | 205.67       | {78} |
| South        | 0.9x | 0.77                      | x | 6.9                    | x | 110.23           | x | 0.63           | x | 0.7            | = | 232.45       | {78} |
| South        | 0.9x | 0.77                      | x | 6.9                    | x | 114.87           | x | 0.63           | x | 0.7            | = | 242.23       | {78} |
| South        | 0.9x | 0.77                      | x | 6.9                    | x | 110.55           | x | 0.63           | x | 0.7            | = | 233.12       | {78} |
| South        | 0.9x | 0.77                      | x | 6.9                    | x | 108.01           | x | 0.63           | x | 0.7            | = | 227.77       | {78} |
| South        | 0.9x | 0.77                      | x | 6.9                    | x | 104.89           | x | 0.63           | x | 0.7            | = | 221.19       | {78} |
| South        | 0.9x | 0.77                      | x | 6.9                    | x | 101.89           | x | 0.63           | x | 0.7            | = | 214.85       | {78} |
| South        | 0.9x | 0.77                      | x | 6.9                    | x | 82.59            | x | 0.63           | x | 0.7            | = | 174.15       | {78} |
| South        | 0.9x | 0.77                      | x | 6.9                    | x | 55.42            | x | 0.63           | x | 0.7            | = | 116.86       | {78} |
| South        | 0.9x | 0.77                      | x | 6.9                    | x | 40.4             | x | 0.63           | x | 0.7            | = | 85.19        | {78} |

Solar gains in watts, calculated for each month

{83}m = Sum(74)m ... (82)m

|        |        |        |        |        |        |        |        |        |        |       |        |       |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|-------|------|
| {83}m= | 115.97 | 194.69 | 262.13 | 323.14 | 364.39 | 363.89 | 349.87 | 318.06 | 282.73 | 213.7 | 138.31 | 99.68 | {83} |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|-------|------|

Total gains – internal and solar {84}m = {73}m + {83}m , watts

|        |        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| {84}m= | 568.64 | 644.81 | 695.99 | 730.62 | 744.43 | 717.88 | 687.69 | 663.33 | 642.44 | 600.02 | 554.79 | 538.97 | {84} |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

## 7. Mean internal temperature (heating season)

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

21 {85}

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

|        |     |     |      |      |      |      |      |      |     |      |     |     |      |
|--------|-----|-----|------|------|------|------|------|------|-----|------|-----|-----|------|
|        | Jan | Feb | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep | Oct  | Nov | Dec |      |
| {86}m= | 1   | 1   | 0.99 | 0.98 | 0.94 | 0.82 | 0.65 | 0.69 | 0.9 | 0.99 | 1   | 1   | {86} |

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

|        |       |    |      |       |       |       |       |       |       |       |       |       |      |
|--------|-------|----|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| {87}m= | 19.87 | 20 | 20.2 | 20.48 | 20.73 | 20.92 | 20.98 | 20.98 | 20.86 | 20.53 | 20.15 | 19.85 | {87} |
|--------|-------|----|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |       |       |       |       |       |      |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|------|
| {88}m= | 20.07 | 20.07 | 20.07 | 20.08 | 20.08 | 20.09 | 20.09 | 20.1 | 20.09 | 20.08 | 20.08 | 20.07 | {88} |
|--------|-------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|------|

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

|        |   |   |      |      |      |      |      |      |      |      |   |   |      |
|--------|---|---|------|------|------|------|------|------|------|------|---|---|------|
| {89}m= | 1 | 1 | 0.99 | 0.98 | 0.92 | 0.75 | 0.53 | 0.58 | 0.85 | 0.98 | 1 | 1 | {89} |
|--------|---|---|------|------|------|------|------|------|------|------|---|---|------|

## TER WorkSheet: New dwelling design stage

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

|                           |       |       |       |       |      |       |       |       |       |       |       |       |      |
|---------------------------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|------|
| (90)m=                    | 18.54 | 18.73 | 19.03 | 19.44 | 19.8 | 20.04 | 20.09 | 20.08 | 19.97 | 19.52 | 18.97 | 18.52 | (90) |
| fLA = Living area ÷ (4) = |       |       |       |       |      |       |       |       |       |       |       |       | (91) |
|                           |       |       |       |       |      |       |       |       |       |       | 0.16  |       |      |

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

|        |       |       |       |      |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (92)m= | 18.75 | 18.93 | 19.22 | 19.6 | 19.95 | 20.18 | 20.23 | 20.23 | 20.11 | 19.68 | 19.15 | 18.73 | (92) |
|--------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |       |      |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (93)m= | 18.75 | 18.93 | 19.22 | 19.6 | 19.95 | 20.18 | 20.23 | 20.23 | 20.11 | 19.68 | 19.15 | 18.73 | (93) |
|--------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|------|

### 9. Space heating calculation

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

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

Utilisation factor for gains, hm:

|        |   |   |      |      |      |      |      |      |      |      |   |   |      |
|--------|---|---|------|------|------|------|------|------|------|------|---|---|------|
| (94)m= | 1 | 1 | 0.99 | 0.97 | 0.91 | 0.76 | 0.55 | 0.59 | 0.85 | 0.97 | 1 | 1 | (94) |
|--------|---|---|------|------|------|------|------|------|------|------|---|---|------|

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

|        |        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| (95)m= | 567.37 | 641.72 | 688.35 | 708.68 | 678.67 | 543.04 | 377.84 | 394.38 | 544.58 | 584.24 | 552.07 | 538.08 | (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= | 1582.98 | 1532.78 | 1385.11 | 1149.59 | 883.63 | 590.26 | 384.14 | 404.11 | 638.98 | 972.63 | 1298.19 | 1573.49 | (97) |
|--------|---------|---------|---------|---------|--------|--------|--------|--------|--------|--------|---------|---------|------|

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

|                                                         |        |        |        |        |        |   |   |   |   |        |         |        |      |
|---------------------------------------------------------|--------|--------|--------|--------|--------|---|---|---|---|--------|---------|--------|------|
| (98)m=                                                  | 755.61 | 598.79 | 518.39 | 317.46 | 152.49 | 0 | 0 | 0 | 0 | 288.96 | 537.2   | 770.35 | (98) |
| Total per year (kWh/year) = Sum(98) <sub>1...12</sub> = |        |        |        |        |        |   |   |   |   |        |         |        | (99) |
|                                                         |        |        |        |        |        |   |   |   |   |        | 3939.25 |        |      |

Space heating requirement in kWh/m<sup>2</sup>/year

|      |       |
|------|-------|
| (99) | 36.75 |
|------|-------|

### 9a. Energy requirements for individual heating systems including micro-CHP

#### Space heating:

Fraction of space heat from secondary/supplementary system

|       |   |
|-------|---|
| (201) | 0 |
|-------|---|

Fraction of space heat from main system(s)

(202) = 1 – (201) =

|       |   |
|-------|---|
| (202) | 1 |
|-------|---|

Fraction of total heating from main system 1

(204) = (202) × [1 – (203)] =

|       |   |
|-------|---|
| (204) | 1 |
|-------|---|

Efficiency of main space heating system 1

|       |      |
|-------|------|
| (206) | 93.4 |
|-------|------|

Efficiency of secondary/supplementary heating system, %

|       |   |
|-------|---|
| (208) | 0 |
|-------|---|

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

kWh/year

Space heating requirement (calculated above)

|        |        |        |        |        |   |   |   |   |        |       |        |
|--------|--------|--------|--------|--------|---|---|---|---|--------|-------|--------|
| 755.61 | 598.79 | 518.39 | 317.46 | 152.49 | 0 | 0 | 0 | 0 | 288.96 | 537.2 | 770.35 |
|--------|--------|--------|--------|--------|---|---|---|---|--------|-------|--------|

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

|        |       |        |        |        |   |   |   |   |        |        |        |
|--------|-------|--------|--------|--------|---|---|---|---|--------|--------|--------|
| 809.01 | 641.1 | 555.02 | 339.89 | 163.26 | 0 | 0 | 0 | 0 | 309.38 | 575.16 | 824.78 |
|--------|-------|--------|--------|--------|---|---|---|---|--------|--------|--------|

Total (kWh/year) = Sum(211)<sub>1...12</sub> = (211)

|       |         |
|-------|---------|
| (211) | 4217.62 |
|-------|---------|

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 |   |       |
| Total (kWh/year) =Sum(215) <sub>1...12</sub> = |   |   |   |   |   |   |   |   |   |   |   | 0 | (215) |

#### Water heating

Output from water heater (calculated above)

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 215.11 | 189.59 | 199.11 | 177.79 | 172.13 | 151.6 | 145.25 | 161.92 | 163.71 | 185.07 | 195.71 | 209.93 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

Efficiency of water heater

|       |      |
|-------|------|
| (216) | 80.3 |
|-------|------|

# TER WorkSheet: New dwelling design stage

|         |       |       |       |       |       |      |      |      |      |       |       |       |       |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|
| {217)m= | 87.95 | 87.75 | 87.35 | 86.49 | 84.75 | 80.3 | 80.3 | 80.3 | 80.3 | 86.17 | 87.46 | 88.03 | {217} |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|

Fuel for water heating, kWh/month

{219)m = {64)m x 100 ÷ {217)m

|                                         |        |        |        |        |        |       |        |        |        |        |        |         |       |
|-----------------------------------------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|---------|-------|
| {219)m=                                 | 244.58 | 216.07 | 227.94 | 205.55 | 203.11 | 188.8 | 180.88 | 201.64 | 203.87 | 214.77 | 223.76 | 238.48  |       |
| Total = Sum({219a}) <sub>i=1,12</sub> = |        |        |        |        |        |       |        |        |        |        |        | 2549.46 | {219} |

## Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

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

472.49

{232}

## 2a CO2 emissions - Individual heating systems including main CHP

|                                                   | Energy<br>kWh/year              | Emission factor<br>kg CO2/kWh |   | Emissions<br>kg CO2/year |       |
|---------------------------------------------------|---------------------------------|-------------------------------|---|--------------------------|-------|
| Space heating (main system 1)                     | {211} x                         | 0.216                         | = | 911                      | {261} |
| Space heating (secondary)                         | {215} x                         | 0.519                         | = | 0                        | {263} |
| Water heating                                     | {219} x                         | 0.216                         | = | 550.68                   | {264} |
| Space and water heating                           | {261} + {262} + {263} + {264} = |                               |   | 1461.69                  | {265} |
| Electricity for pumps, fans and electric keep-hot | {231} x                         | 0.519                         | = | 38.93                    | {267} |
| Electricity for lighting                          | {232} x                         | 0.519                         | = | 245.22                   | {268} |
| Total CO2, kg/year                                |                                 | sum of {265}...{271} =        |   | 1745.84                  | {272} |

TER =

16.29

{273}