

# Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.18  
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## 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 143

**Address :** Plot 143, 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) 16.51 kg/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 15.86 kg/m<sup>2</sup> OK

## 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 48.2 kWh/m<sup>2</sup>

Dwelling Fabric Energy Efficiency (DFEE) 44.2 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                                                                                                                                                                                                                                              |    |

# Regulations Compliance Report

## 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: South 5.35m<sup>2</sup>  
 Windows facing: North 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  
**Software Name:** Stroma FSAP 2012

**Stroma Number:** STRO011196  
**Software Version:** Version: 1.0.4.18

## Property Address: Plot 143

**Address :** Plot 143, 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)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

(39) + (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 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=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 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 | 6.9                    | x | 10.63            | x | 0.45           | x | 1.11           | = | 25.42        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 20.32            | x | 0.45           | x | 1.11           | = | 48.58        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 34.53            | x | 0.45           | x | 1.11           | = | 82.56        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 55.46            | x | 0.45           | x | 1.11           | = | 132.61       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 74.72            | x | 0.45           | x | 1.11           | = | 178.63       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 79.99            | x | 0.45           | x | 1.11           | = | 191.23       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 74.68            | x | 0.45           | x | 1.11           | = | 178.54       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 59.25            | x | 0.45           | x | 1.11           | = | 141.65       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 41.52            | x | 0.45           | x | 1.11           | = | 99.26        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 24.19            | x | 0.45           | x | 1.11           | = | 57.83        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 13.12            | x | 0.45           | x | 1.11           | = | 31.36        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 8.86             | x | 0.45           | x | 1.11           | = | 21.19        | (74) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 46.75            | x | 0.45           | x | 1.11           | = | 86.67        | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 76.57            | x | 0.45           | x | 1.11           | = | 141.94       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 97.53            | x | 0.45           | x | 1.11           | = | 180.81       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 110.23           | x | 0.45           | x | 1.11           | = | 204.35       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 114.87           | x | 0.45           | x | 1.11           | = | 212.95       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 110.55           | x | 0.45           | x | 1.11           | = | 204.93       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 108.01           | x | 0.45           | x | 1.11           | = | 200.23       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 104.89           | x | 0.45           | x | 1.11           | = | 194.45       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 101.89           | x | 0.45           | x | 1.11           | = | 188.87       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 82.59            | x | 0.45           | x | 1.11           | = | 153.1        | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 55.42            | x | 0.45           | x | 1.11           | = | 102.73       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 40.4             | x | 0.45           | x | 1.11           | = | 74.89        | (78) |

Solar gains in watts, calculated for each month

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

|        |        |        |        |        |        |        |        |       |        |        |        |       |      |
|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|-------|------|
| {83}m= | 112.09 | 190.52 | 263.36 | 336.96 | 391.58 | 396.16 | 378.77 | 336.1 | 288.13 | 210.93 | 134.09 | 96.08 | {83} |
|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|-------|------|

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

|        |        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| {84}m= | 769.82 | 842.59 | 889.06 | 922.11 | 935.18 | 903.12 | 864.87 | 832.08 | 807.98 | 771.54 | 739.67 | 735.74 | {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= | 0.98 | 0.97 | 0.95 | 0.91 | 0.82 | 0.67 | 0.52 | 0.56 | 0.76 | 0.91 | 0.96 | 0.98 | {86} |

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

|        |       |       |      |      |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| {87}m= | 19.42 | 19.61 | 19.9 | 20.3 | 20.64 | 20.88 | 20.97 | 20.96 | 20.81 | 20.39 | 19.86 | 19.41 | {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 | 0.94 | 0.88 | 0.78 | 0.6 | 0.42 | 0.46 | 0.7 | 0.89 | 0.96 | 0.98 | {89} |
|--------|------|------|------|------|------|-----|------|------|-----|------|------|------|------|

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

|                           |       |       |       |       |       |       |       |       |       |       |       |       |      |
|---------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (90)m=                    | 17.91 | 18.18 | 18.61 | 19.19 | 19.66 | 19.97 | 20.05 | 20.05 | 19.88 | 19.32 | 18.57 | 17.91 | (90) |
| fLA = Living area ÷ (4) = |       |       |       |       |       |       |       |       |       |       |       |       | (91) |
|                           |       |       |       |       |       |       |       |       |       |       |       | 0.16  |      |

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

|        |       |       |       |       |       |       |      |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|------|
| (92)m= | 18.15 | 18.41 | 18.81 | 19.37 | 19.81 | 20.12 | 20.2 | 20.19 | 20.03 | 19.49 | 18.77 | 18.15 | (92) |
|--------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|------|

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

|        |    |       |       |       |       |       |       |       |       |       |       |    |      |
|--------|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|------|
| (93)m= | 18 | 18.26 | 18.66 | 19.22 | 19.66 | 19.97 | 20.05 | 20.04 | 19.88 | 19.34 | 18.62 | 18 | (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 | 0.92 | 0.86 | 0.76 | 0.59 | 0.42 | 0.46 | 0.68 | 0.87 | 0.94 | 0.96 | (94) |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|

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

|        |        |        |        |        |        |     |        |       |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|-----|--------|-------|--------|--------|--------|--------|------|
| (95)m= | 738.11 | 794.92 | 815.28 | 795.61 | 714.45 | 536 | 364.51 | 380.1 | 551.79 | 667.81 | 694.55 | 709.07 | (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= | 1602.15 | 1553.46 | 1406.43 | 1159.94 | 889.99 | 582.79 | 374.25 | 393.25 | 634.83 | 977.14 | 1302.8 | 1577.98 | (97) |
|--------|---------|---------|---------|---------|--------|--------|--------|--------|--------|--------|--------|---------|------|

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

|                                                         |        |        |        |        |       |   |   |   |   |        |        |         |      |
|---------------------------------------------------------|--------|--------|--------|--------|-------|---|---|---|---|--------|--------|---------|------|
| (98)m=                                                  | 642.85 | 509.74 | 439.82 | 262.32 | 130.6 | 0 | 0 | 0 | 0 | 230.14 | 437.94 | 646.47  | (98) |
| Total per year (kWh/year) = Sum(98) <sub>1...12</sub> = |        |        |        |        |       |   |   |   |   |        |        |         | (99) |
|                                                         |        |        |        |        |       |   |   |   |   |        |        | 3299.87 |      |

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

30.78 (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               | $\{204\} = \{202\} \times [1 - \{203\}] =$ | 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)

|        |        |        |        |       |   |   |   |   |        |        |        |
|--------|--------|--------|--------|-------|---|---|---|---|--------|--------|--------|
| 642.85 | 509.74 | 439.82 | 262.32 | 130.6 | 0 | 0 | 0 | 0 | 230.14 | 437.94 | 646.47 |
|--------|--------|--------|--------|-------|---|---|---|---|--------|--------|--------|

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

|        |        |        |        |        |   |   |   |   |       |        |        |
|--------|--------|--------|--------|--------|---|---|---|---|-------|--------|--------|
| 710.33 | 563.25 | 485.98 | 289.85 | 144.31 | 0 | 0 | 0 | 0 | 254.3 | 483.91 | 714.33 |
|--------|--------|--------|--------|--------|---|---|---|---|-------|--------|--------|

Total (kWh/year) = Sum(211)<sub>1...12</sub> = 3646.27 (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= | 89.79 | 89.73 | 89.61 | 89.35 | 88.83 | 87.3 | 87.3 | 87.3 | 87.3 | 89.22 | 89.62 | 89.8 | (217) |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|------|-------|

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

|                              |        |        |        |       |        |        |        |        |        |        |        |         |       |
|------------------------------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|---------|-------|
| (219)m=                      | 198.59 | 174.23 | 181.06 | 159.8 | 155.32 | 138.02 | 129.52 | 146.31 | 147.38 | 166.09 | 178.59 | 192.76  |       |
| Total = Sum(219a)...(219j) = |        |        |        |       |        |        |        |        |        |        |        | 1967.68 | (219) |

## Annual totals

|                                                                           | kWh/year                 | kWh/year |
|---------------------------------------------------------------------------|--------------------------|----------|
| Space heating fuel used, main system 1                                    |                          | 3646.27  |
| Water heating fuel used                                                   |                          | 1967.68  |
| 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                     | 126.89              |
| 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                     | 68.48               |
| 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) = | 396.73 | (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>  |                                  | 84.73 | (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                         | 787.59                   |
| Space heating (secondary)     | (215) x            | 0.519                         | 0                        |
| Water heating                 | (219) x            | 0.216                         | 425.02                   |

## SAP WorkSheet: New dwelling design stage

|                                                   |                                 |       |   |         |       |
|---------------------------------------------------|---------------------------------|-------|---|---------|-------|
| Space and water heating                           | {261} + {262} + {263} + {264} = |       |   | 1212.61 | {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} =         |       |   | 1532.75 | {272} |
| <b>CO2 emissions per m²</b>                       | {272} ÷ (4) =                   |       |   | 14.3    | {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              | = | 4448.45               | {261} |
| Space heating (secondary)                         | {215} x                         | 3.07              | = | 0                     | {263} |
| Energy for water heating                          | {219} x                         | 1.22              | = | 2400.57               | {264} |
| Space and water heating                           | {261} + {262} + {263} + {264} = |                   |   | 6849.02               | {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} =          |                   |   | 8742.71               | {272} |
| <b>Primary energy kWh/m²/year</b>                 | {272} ÷ (4) =                   |                   |   | 81.56                 | {273} |

# DFEE WorkSheet: New dwelling design stage

## User Details

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**Software Name:** Stroma FSAP 2012 **Software Version:** Version: 1.0.4.18

## Property Address: Plot 143

**Address :** Plot 143, 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) 0

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

(23b) 0

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 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 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 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 capacity 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 | 6.9                    | x | 10.63            | x | 0.45           | x | 1.11           | = | 25.42        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 20.32            | x | 0.45           | x | 1.11           | = | 48.58        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 34.53            | x | 0.45           | x | 1.11           | = | 82.56        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 55.46            | x | 0.45           | x | 1.11           | = | 132.61       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 74.72            | x | 0.45           | x | 1.11           | = | 178.63       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 79.99            | x | 0.45           | x | 1.11           | = | 191.23       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 74.68            | x | 0.45           | x | 1.11           | = | 178.54       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 59.25            | x | 0.45           | x | 1.11           | = | 141.65       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 41.52            | x | 0.45           | x | 1.11           | = | 99.26        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 24.19            | x | 0.45           | x | 1.11           | = | 57.83        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 13.12            | x | 0.45           | x | 1.11           | = | 31.36        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x | 8.86             | x | 0.45           | x | 1.11           | = | 21.19        | (74) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 46.75            | x | 0.45           | x | 1.11           | = | 86.67        | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 76.57            | x | 0.45           | x | 1.11           | = | 141.94       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 97.53            | x | 0.45           | x | 1.11           | = | 180.81       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 110.23           | x | 0.45           | x | 1.11           | = | 204.35       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 114.87           | x | 0.45           | x | 1.11           | = | 212.95       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 110.55           | x | 0.45           | x | 1.11           | = | 204.93       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 108.01           | x | 0.45           | x | 1.11           | = | 200.23       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 104.89           | x | 0.45           | x | 1.11           | = | 194.45       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 101.89           | x | 0.45           | x | 1.11           | = | 188.87       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 82.59            | x | 0.45           | x | 1.11           | = | 153.1        | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 55.42            | x | 0.45           | x | 1.11           | = | 102.73       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x | 40.4             | x | 0.45           | x | 1.11           | = | 74.89        | (78) |

Solar gains in watts, calculated for each month

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

|        |        |        |        |        |        |        |        |       |        |        |        |       |      |
|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|-------|------|
| {83}m= | 112.09 | 190.52 | 263.36 | 336.96 | 391.58 | 396.16 | 378.77 | 336.1 | 288.13 | 210.93 | 134.09 | 96.08 | {83} |
|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|-------|------|

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

|        |        |        |        |        |        |        |       |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|------|
| {84}m= | 518.15 | 594.89 | 653.21 | 703.02 | 732.43 | 713.81 | 682.1 | 643.83 | 608.77 | 555.49 | 506.05 | 489.61 | {84} |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|------|

## 7. Mean internal temperature (heating season)

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

21 {85}

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

|        |      |      |      |      |     |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|-----|------|------|------|------|------|------|------|------|
|        | Jan  | Feb  | Mar  | Apr  | May | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |      |
| {86}m= | 0.99 | 0.99 | 0.98 | 0.95 | 0.9 | 0.79 | 0.65 | 0.69 | 0.87 | 0.96 | 0.99 | 0.99 | {86} |

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

|        |       |       |      |       |       |       |       |      |       |       |       |       |      |
|--------|-------|-------|------|-------|-------|-------|-------|------|-------|-------|-------|-------|------|
| {87}m= | 19.08 | 19.28 | 19.6 | 20.04 | 20.46 | 20.79 | 20.93 | 20.9 | 20.66 | 20.13 | 19.54 | 19.06 | {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 | 0.99 | 0.97 | 0.94 | 0.87 | 0.72 | 0.53 | 0.58 | 0.82 | 0.95 | 0.99 | 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=                    | 18.23 | 18.43 | 18.75 | 19.2 | 19.6 | 19.91 | 20.01 | 20 | 19.8 | 19.29 | 18.7 | 18.22 | (90) |
| fLA = Living area ÷ (4) = |       |       |       |      |      |       |       |    |      |       |      |       | (91) |
| 0.16                      |       |       |       |      |      |       |       |    |      |       |      |       | (91) |

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (92)m= | 18.36 | 18.56 | 18.89 | 19.34 | 19.74 | 20.05 | 20.15 | 20.14 | 19.94 | 19.42 | 18.83 | 18.36 | (92) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (93)m= | 18.36 | 18.56 | 18.89 | 19.34 | 19.74 | 20.05 | 20.15 | 20.14 | 19.94 | 19.42 | 18.83 | 18.36 | (93) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

## 9. Space heating requirement

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

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

Utilisation factor for gains, hm:

|        |      |      |      |      |      |      |      |     |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|-----|------|------|------|------|------|
| (94)m= | 0.99 | 0.98 | 0.97 | 0.93 | 0.86 | 0.72 | 0.55 | 0.6 | 0.81 | 0.94 | 0.98 | 0.99 | (94) |
|--------|------|------|------|------|------|------|------|-----|------|------|------|------|------|

Useful gains, hmGm, W = (94)m × (84)m

|        |        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| (95)m= | 511.97 | 583.15 | 630.76 | 655.39 | 630.46 | 514.47 | 374.26 | 384.26 | 495.55 | 523.85 | 496.26 | 484.79 | (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= | 1667.94 | 1613.56 | 1456.68 | 1203.24 | 923.4 | 614.67 | 401 | 420.85 | 663.33 | 1013.67 | 1358.23 | 1651.27 | (97) |
|--------|---------|---------|---------|---------|-------|--------|-----|--------|--------|---------|---------|---------|------|

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

|                                       |        |        |        |        |        |   |   |   |   |        |        |        |      |
|---------------------------------------|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|------|
| (98)m=                                | 860.04 | 692.43 | 614.48 | 394.45 | 217.94 | 0 | 0 | 0 | 0 | 364.43 | 620.62 | 867.86 | (98) |
| Total per year (kWh/year) = Sum(98) = |        |        |        |        |        |   |   |   |   |        |        |        | (98) |
| 4632.25                               |        |        |        |        |        |   |   |   |   |        |        |        | (98) |

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

43.21 (99)

## 9. 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 | 0.73 | 0.81 | 0.79 | 0 | 0 | 0 | 0 | (101) |
|---------|---|---|---|---|---|------|------|------|---|---|---|---|-------|

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

|         |   |   |   |   |   |        |        |        |   |   |   |   |       |
|---------|---|---|---|---|---|--------|--------|--------|---|---|---|---|-------|
| (102)m= | 0 | 0 | 0 | 0 | 0 | 779.84 | 678.99 | 672.51 | 0 | 0 | 0 | 0 | (102) |
|---------|---|---|---|---|---|--------|--------|--------|---|---|---|---|-------|

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

|         |   |   |   |   |   |        |        |        |   |   |   |   |       |
|---------|---|---|---|---|---|--------|--------|--------|---|---|---|---|-------|
| (103)m= | 0 | 0 | 0 | 0 | 0 | 944.48 | 905.14 | 862.77 | 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 | 118.54 | 168.25 | 141.55 | 0 | 0 | 0 | 0 | (104) |
| Total = Sum(104) = |   |   |   |   |   |        |        |        |   |   |   |   | (104) |
| 428.34             |   |   |   |   |   |        |        |        |   |   |   |   | (104) |

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 | (105) |
| Total = Sum(105) = |   |   |   |   |   |      |      |      |   |   |   |   | (105) |
| 0                  |   |   |   |   |   |      |      |      |   |   |   |   | (105) |

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

|                    |   |   |   |   |   |       |       |       |   |   |   |   |       |
|--------------------|---|---|---|---|---|-------|-------|-------|---|---|---|---|-------|
| (107)m=            | 0 | 0 | 0 | 0 | 0 | 29.64 | 42.06 | 35.39 | 0 | 0 | 0 | 0 | (107) |
| Total = Sum(107) = |   |   |   |   |   |       |       |       |   |   |   |   | (107) |
| 107.09             |   |   |   |   |   |       |       |       |   |   |   |   | (107) |

## DFEE WorkSheet: New dwelling design stage

|                                                                                        |                |                                    |       |
|----------------------------------------------------------------------------------------|----------------|------------------------------------|-------|
| Space cooling requirement in kWh/m <sup>2</sup> /year                                  | (107) ÷ (4) =  | <input type="text" value="1"/>     | (108) |
| 91 Fabric Energy Efficiency, calculated only under special conditions, see section 1.5 |                |                                    |       |
| Fabric Energy Efficiency                                                               | (99) + (108) = | <input type="text" value="44.21"/> | (109) |

# DER WorkSheet: New dwelling design stage

## User Details

**Assessor Name:** Gerard Mcguigan  
**Software Name:** Stroma FSAP 2012

**Stroma Number:** STRO011196  
**Software Version:** Version: 1.0.4.18

## Property Address: Plot 143

**Address :** Plot 143, 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 | 6.9                    | x | 10.63            | x | 0.45           | x | 1.11           | = | 25.42        | {74} |
| North        | 0.9x | 0.77                      | x | 6.9                    | x | 20.32            | x | 0.45           | x | 1.11           | = | 48.58        | {74} |
| North        | 0.9x | 0.77                      | x | 6.9                    | x | 34.53            | x | 0.45           | x | 1.11           | = | 82.56        | {74} |
| North        | 0.9x | 0.77                      | x | 6.9                    | x | 55.46            | x | 0.45           | x | 1.11           | = | 132.61       | {74} |
| North        | 0.9x | 0.77                      | x | 6.9                    | x | 74.72            | x | 0.45           | x | 1.11           | = | 178.63       | {74} |
| North        | 0.9x | 0.77                      | x | 6.9                    | x | 79.99            | x | 0.45           | x | 1.11           | = | 191.23       | {74} |
| North        | 0.9x | 0.77                      | x | 6.9                    | x | 74.68            | x | 0.45           | x | 1.11           | = | 178.54       | {74} |
| North        | 0.9x | 0.77                      | x | 6.9                    | x | 59.25            | x | 0.45           | x | 1.11           | = | 141.65       | {74} |
| North        | 0.9x | 0.77                      | x | 6.9                    | x | 41.52            | x | 0.45           | x | 1.11           | = | 99.26        | {74} |
| North        | 0.9x | 0.77                      | x | 6.9                    | x | 24.19            | x | 0.45           | x | 1.11           | = | 57.83        | {74} |
| North        | 0.9x | 0.77                      | x | 6.9                    | x | 13.12            | x | 0.45           | x | 1.11           | = | 31.36        | {74} |
| North        | 0.9x | 0.77                      | x | 6.9                    | x | 8.86             | x | 0.45           | x | 1.11           | = | 21.19        | {74} |
| South        | 0.9x | 0.77                      | x | 5.35                   | x | 46.75            | x | 0.45           | x | 1.11           | = | 86.67        | {78} |
| South        | 0.9x | 0.77                      | x | 5.35                   | x | 76.57            | x | 0.45           | x | 1.11           | = | 141.94       | {78} |
| South        | 0.9x | 0.77                      | x | 5.35                   | x | 97.53            | x | 0.45           | x | 1.11           | = | 180.81       | {78} |
| South        | 0.9x | 0.77                      | x | 5.35                   | x | 110.23           | x | 0.45           | x | 1.11           | = | 204.35       | {78} |
| South        | 0.9x | 0.77                      | x | 5.35                   | x | 114.87           | x | 0.45           | x | 1.11           | = | 212.95       | {78} |
| South        | 0.9x | 0.77                      | x | 5.35                   | x | 110.55           | x | 0.45           | x | 1.11           | = | 204.93       | {78} |
| South        | 0.9x | 0.77                      | x | 5.35                   | x | 108.01           | x | 0.45           | x | 1.11           | = | 200.23       | {78} |
| South        | 0.9x | 0.77                      | x | 5.35                   | x | 104.89           | x | 0.45           | x | 1.11           | = | 194.45       | {78} |
| South        | 0.9x | 0.77                      | x | 5.35                   | x | 101.89           | x | 0.45           | x | 1.11           | = | 188.87       | {78} |
| South        | 0.9x | 0.77                      | x | 5.35                   | x | 82.59            | x | 0.45           | x | 1.11           | = | 153.1        | {78} |
| South        | 0.9x | 0.77                      | x | 5.35                   | x | 55.42            | x | 0.45           | x | 1.11           | = | 102.73       | {78} |
| South        | 0.9x | 0.77                      | x | 5.35                   | x | 40.4             | x | 0.45           | x | 1.11           | = | 74.89        | {78} |

Solar gains in watts, calculated for each month

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

|        |        |        |        |        |        |        |        |       |        |        |        |       |      |
|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|-------|------|
| {83}m= | 112.09 | 190.52 | 263.36 | 336.96 | 391.58 | 396.16 | 378.77 | 336.1 | 288.13 | 210.93 | 134.09 | 96.08 | {83} |
|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|-------|------|

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

|        |        |        |        |        |        |        |        |        |        |        |        |     |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----|------|
| {84}m= | 552.38 | 628.27 | 684.84 | 732.28 | 760.14 | 739.34 | 705.78 | 669.88 | 635.67 | 584.86 | 538.19 | 523 | {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 | 0.76 | 0.62 | 0.66 | 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= | 19.15 | 19.35 | 19.67 | 20.11 | 20.51 | 20.82 | 20.94 | 20.92 | 20.71 | 20.2 | 19.62 | 19.14 | {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 | 0.97 | 0.93 | 0.86 | 0.69 | 0.51 | 0.55 | 0.8 | 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=                    | 17.52 | 17.81 | 18.28 | 18.94 | 19.5 | 19.91 | 20.04 | 20.03 | 19.77 | 19.06 | 18.22 | 17.52 | (90) |
| fLA = Living area ÷ (4) = |       |       |       |       |      |       |       |       |       |       |       |       | (91) |
|                           |       |       |       |       |      |       |       |       |       |       | 0.16  |       |      |

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

|        |       |       |      |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (92)m= | 17.78 | 18.06 | 18.5 | 19.12 | 19.66 | 20.06 | 20.18 | 20.17 | 19.92 | 19.24 | 18.44 | 17.78 | (92) |
|--------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (93)m= | 17.63 | 17.91 | 18.35 | 18.97 | 19.51 | 19.91 | 20.03 | 20.02 | 19.77 | 19.09 | 18.29 | 17.63 | (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 | 0.96 | 0.92 | 0.83 | 0.68 | 0.5 | 0.55 | 0.78 | 0.93 | 0.97 | 0.99 | (94) |
|--------|------|------|------|------|------|------|-----|------|------|------|------|------|------|

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

|        |        |        |        |        |        |        |        |        |        |        |       |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|------|
| (95)m= | 542.94 | 611.33 | 654.07 | 670.35 | 634.25 | 503.05 | 355.03 | 366.86 | 494.47 | 541.46 | 523.6 | 515.54 | (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= | 1558.95 | 1512.64 | 1370.4 | 1132.4 | 872.78 | 576.21 | 372.36 | 390.64 | 622.9 | 949.43 | 1265.5 | 1535.95 | (97) |
|--------|---------|---------|--------|--------|--------|--------|--------|--------|-------|--------|--------|---------|------|

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

|                                                         |        |        |        |        |        |   |   |   |   |        |         |        |      |
|---------------------------------------------------------|--------|--------|--------|--------|--------|---|---|---|---|--------|---------|--------|------|
| (98)m=                                                  | 755.91 | 605.68 | 532.95 | 332.68 | 177.46 | 0 | 0 | 0 | 0 | 303.53 | 534.17  | 759.18 | (98) |
| Total per year (kWh/year) = Sum(98) <sub>1...12</sub> = |        |        |        |        |        |   |   |   |   |        |         |        | (99) |
|                                                         |        |        |        |        |        |   |   |   |   |        | 4001.56 |        |      |

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

37.33 (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)

|        |        |        |        |        |   |   |   |   |        |        |        |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|
| 755.91 | 605.68 | 532.95 | 332.68 | 177.46 | 0 | 0 | 0 | 0 | 303.53 | 534.17 | 759.18 |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|

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

|        |        |        |       |        |   |   |   |   |       |        |        |
|--------|--------|--------|-------|--------|---|---|---|---|-------|--------|--------|
| 835.26 | 669.26 | 588.89 | 367.6 | 196.09 | 0 | 0 | 0 | 0 | 335.4 | 590.24 | 838.87 |
|--------|--------|--------|-------|--------|---|---|---|---|-------|--------|--------|

Total (kWh/year) = Sum(211)<sub>1...12</sub> = 4421.61 (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= | 89.87 | 89.82 | 89.73 | 89.51 | 89.07 | 87.3 | 87.3 | 87.3 | 87.3 | 89.42 | 89.74 | 89.89 | {217} |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

|                                         |       |        |        |       |       |        |        |        |        |        |        |         |       |
|-----------------------------------------|-------|--------|--------|-------|-------|--------|--------|--------|--------|--------|--------|---------|-------|
| {219}m=                                 | 198.4 | 174.05 | 180.83 | 159.5 | 154.9 | 138.02 | 129.52 | 146.31 | 147.38 | 165.71 | 178.35 | 192.58  |       |
| Total = Sum({219a}) <sub>i=1,12</sub> = |       |        |        |       |       |        |        |        |        |        |        | 1965.54 | {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                         | 955.07 {261}             |
| Space heating (secondary)                         | {215} x                         | 0.519                         | 0 {263}                  |
| Water heating                                     | {219} x                         | 0.216                         | 424.56 {264}             |
| Space and water heating                           | {261} + {262} + {263} + {264} = |                               | 1379.62 {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} =        | 1699.76 {272}            |
| <b>Dwelling CO2 Emission Rate</b>                 |                                 | {272} ÷ (4) =                 | 15.86 {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 143

**Address :** Plot 143, 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 |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|

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 |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|

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 |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|

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 |
|---------|-----|------|------|------|------|------|------|------|------|------|------|------|

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 |
|--------|-----|------|------|------|------|------|------|------|------|------|------|------|

## 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            | 1                           | 2.1         |                 | (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           | 0.13                        | 6.967999    |                 | (28)       |
| Walls                      | 101.67          | 14.35       | 87.32          | 0.18                        | 15.72       |                 | (29)       |
| Roof                       | 53.6            | 0           | 53.6           | 0.13                        | 6.97        |                 | (30)       |
| Total area of elements, m² |                 |             | 208.87         |                             |             |                 | (31)       |
| Party wall                 |                 |             | 45.82          | 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  $1/[(1/U\text{-value})+0.04]$  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) = 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.

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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)

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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=

|       |       |       |       |      |       |       |      |       |       |       |       |
|-------|-------|-------|-------|------|-------|-------|------|-------|-------|-------|-------|
| 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 | 6.9                    | x                | 10.63  | x | 0.63           | x | 0.7            | = | 22.42        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x                | 20.32  | x | 0.63           | x | 0.7            | = | 42.85        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x                | 34.53  | x | 0.63           | x | 0.7            | = | 72.81        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x                | 55.46  | x | 0.63           | x | 0.7            | = | 116.96       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x                | 74.72  | x | 0.63           | x | 0.7            | = | 157.56       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x                | 79.99  | x | 0.63           | x | 0.7            | = | 168.67       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x                | 74.68  | x | 0.63           | x | 0.7            | = | 157.47       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x                | 59.25  | x | 0.63           | x | 0.7            | = | 124.93       | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x                | 41.52  | x | 0.63           | x | 0.7            | = | 87.55        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x                | 24.19  | x | 0.63           | x | 0.7            | = | 51.01        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x                | 13.12  | x | 0.63           | x | 0.7            | = | 27.66        | (74) |
| North        | 0.9x                      | 0.77 | x | 6.9                    | x                | 8.86   | x | 0.63           | x | 0.7            | = | 18.69        | (74) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x                | 46.75  | x | 0.63           | x | 0.7            | = | 76.44        | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x                | 76.57  | x | 0.63           | x | 0.7            | = | 125.19       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x                | 97.53  | x | 0.63           | x | 0.7            | = | 159.47       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x                | 110.23 | x | 0.63           | x | 0.7            | = | 180.24       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x                | 114.87 | x | 0.63           | x | 0.7            | = | 187.82       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x                | 110.55 | x | 0.63           | x | 0.7            | = | 180.75       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x                | 108.01 | x | 0.63           | x | 0.7            | = | 176.6        | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x                | 104.89 | x | 0.63           | x | 0.7            | = | 171.51       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x                | 101.89 | x | 0.63           | x | 0.7            | = | 166.59       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x                | 82.59  | x | 0.63           | x | 0.7            | = | 135.03       | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x                | 55.42  | x | 0.63           | x | 0.7            | = | 90.61        | (78) |
| South        | 0.9x                      | 0.77 | x | 5.35                   | x                | 40.4   | x | 0.63           | x | 0.7            | = | 66.05        | (78) |

Solar gains in watts, calculated for each month

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

|        |       |        |        |       |        |        |        |        |        |        |        |       |      |
|--------|-------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|-------|------|
| {83}m= | 98.86 | 168.04 | 232.29 | 297.2 | 345.37 | 349.42 | 334.08 | 296.44 | 254.13 | 186.04 | 118.27 | 84.74 | {83} |
|--------|-------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|-------|------|

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

|        |        |        |        |        |        |       |       |       |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|-------|-------|-------|--------|--------|--------|--------|------|
| {84}m= | 551.53 | 618.16 | 666.15 | 704.67 | 725.41 | 703.4 | 671.9 | 641.7 | 613.84 | 572.36 | 534.75 | 524.03 | {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   | 1   | 0.99 | 0.95 | 0.83 | 0.66 | 0.71 | 0.91 | 0.99 | 1   | 1   | {86} |

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| {87}m= | 19.85 | 19.98 | 20.18 | 20.45 | 20.72 | 20.92 | 20.98 | 20.97 | 20.84 | 20.51 | 20.13 | 19.84 | {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 | 0.76 | 0.54 | 0.59 | 0.87 | 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=                    | 18.52 | 18.7 | 19 | 19.41 | 19.78 | 20.03 | 20.09 | 20.08 | 19.95 | 19.48 | 18.94 | 18.5 | (90) |
| fLA = Living area ÷ (4) = |       |      |    |       |       |       |       |       |       |       |       |      | (91) |
|                           |       |      |    |       |       |       |       |       |       |       | 0.16  |      | (91) |

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

|        |       |      |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (92)m= | 18.73 | 18.9 | 19.18 | 19.57 | 19.93 | 20.17 | 20.23 | 20.22 | 20.09 | 19.65 | 19.13 | 18.71 | (92) |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |      |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (93)m= | 18.73 | 18.9 | 19.18 | 19.57 | 19.93 | 20.17 | 20.23 | 20.22 | 20.09 | 19.65 | 19.13 | 18.71 | (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 | 0.92 | 0.77 | 0.56 | 0.61 | 0.87 | 0.98 | 1 | 1 | (94) |
|--------|---|---|------|------|------|------|------|------|------|------|---|---|------|

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

|        |        |        |       |        |        |        |        |       |        |        |        |        |      |
|--------|--------|--------|-------|--------|--------|--------|--------|-------|--------|--------|--------|--------|------|
| (95)m= | 550.46 | 615.73 | 660.1 | 686.33 | 666.43 | 539.26 | 377.05 | 392.7 | 531.22 | 559.92 | 532.55 | 523.27 | (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= | 1580.66 | 1529.21 | 1381.21 | 1146.52 | 881.96 | 589.79 | 384.05 | 403.91 | 637.23 | 969.3 | 1295.54 | 1571.48 | (97) |
|--------|---------|---------|---------|---------|--------|--------|--------|--------|--------|-------|---------|---------|------|

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

|                                                         |        |        |        |        |        |   |   |   |   |        |         |        |      |
|---------------------------------------------------------|--------|--------|--------|--------|--------|---|---|---|---|--------|---------|--------|------|
| (98)m=                                                  | 766.46 | 613.86 | 536.51 | 331.34 | 160.36 | 0 | 0 | 0 | 0 | 304.58 | 549.35  | 779.86 | (98) |
| Total per year (kWh/year) = Sum(98) <sub>1...12</sub> = |        |        |        |        |        |   |   |   |   |        |         |        | (99) |
|                                                         |        |        |        |        |        |   |   |   |   |        | 4042.32 |        | (99) |

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

37.71 (99)

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

### Space heating:

|                                                            |                                            |            |
|------------------------------------------------------------|--------------------------------------------|------------|
| 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               | $\{204\} = \{202\} \times [1 - \{203\}] =$ | 1 (204)    |
| Efficiency of main space heating system 1                  |                                            | 93.4 (206) |
| Efficiency of secondary/supplementary heating system, %    |                                            | 0 (208)    |

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

Space heating requirement (calculated above)

|        |        |        |        |        |   |   |   |   |        |        |        |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|
| 766.46 | 613.86 | 536.51 | 331.34 | 160.36 | 0 | 0 | 0 | 0 | 304.58 | 549.35 | 779.86 |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|

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

|        |        |        |        |        |   |   |   |   |        |        |        |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|
| 820.62 | 657.23 | 574.42 | 354.75 | 171.69 | 0 | 0 | 0 | 0 | 326.11 | 588.17 | 834.97 |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|

Total (kWh/year) = Sum(211)<sub>1...12</sub> = 4327.97 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

|                                                |   |   |   |   |   |   |   |   |   |   |   |   |       |
|------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|-------|
| [(215)m*(215)]*(215)                           |   |   |   |   |   |   |   |   |   |   |   |   |       |
| (215)m=                                        | 0 | 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 80.3 (216)

## TER WorkSheet: New dwelling design stage

|         |       |       |       |      |       |      |      |      |      |      |       |       |       |
|---------|-------|-------|-------|------|-------|------|------|------|------|------|-------|-------|-------|
| {217}m= | 87.98 | 87.79 | 87.42 | 86.6 | 84.87 | 80.3 | 80.3 | 80.3 | 80.3 | 86.3 | 87.51 | 88.05 | {217} |
|---------|-------|-------|-------|------|-------|------|------|------|------|------|-------|-------|-------|

Fuel for water heating, kWh/month

{219}m = {64}m x 100 ÷ {217}m

|                                         |        |        |        |        |        |       |        |        |        |        |        |         |       |
|-----------------------------------------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|---------|-------|
| {219}m=                                 | 244.51 | 215.95 | 227.75 | 205.31 | 202.81 | 188.8 | 180.88 | 201.64 | 203.87 | 214.45 | 223.64 | 238.42  |       |
| Total = Sum({219a}) <sub>i=1,12</sub> = |        |        |        |        |        |       |        |        |        |        |        | 2548.04 | {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                         | = | 934.84                   | {261} |
| Space heating (secondary)                         | {215} x                         | 0.519                         | = | 0                        | {263} |
| Water heating                                     | {219} x                         | 0.216                         | = | 550.38                   | {264} |
| Space and water heating                           | {261} + {262} + {263} + {264} = |                               |   | 1485.22                  | {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} =          |                               |   | 1769.37                  | {272} |

TER =

16.51

{273}