

# 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: 89m<sup>2</sup>

**Site Reference :** Hedgerows Westgate

**Plot Reference:** Plot 149

**Address :** Plot 149, 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) 17.48 kg/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 16.84 kg/m<sup>2</sup> OK

## 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 49.4 kWh/m<sup>2</sup>

Dwelling Fabric Energy Efficiency (DFEE) 45.8 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: West 4.55m<sup>2</sup>

Windows facing: East 7.95m<sup>2</sup>

Ventilation rate: 4.00

Blinds/curtains: None

## 10 Key features

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 149

**Address :** Plot 149, The Hedgerows, Westergate, PO20

## 1. General dwelling dimensions

|                                                           | Area(m <sup>2</sup> ) |   | Av. Height(m) |                                      | Volume(m <sup>3</sup> ) |
|-----------------------------------------------------------|-----------------------|---|---------------|--------------------------------------|-------------------------|
| Ground floor                                              | 44.5 (1a)             | x | 2.3 (2a)      | =                                    | 102.35 (3a)             |
| First floor                                               | 44.5 (1b)             | x | 2.6 (2b)      | =                                    | 115.7 (3b)              |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 89 (4)                |   |               |                                      |                         |
| Dwelling volume                                           |                       |   |               | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 218.05 (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 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                         |                              |                         | 4.55                       | $\times 1/[1/(1.4) + 0.04]$ | 6.03        |                              | (27)         |
| Windows Type 2                         |                              |                         | 7.95                       | $\times 1/[1/(1.4) + 0.04]$ | 10.54       |                              | (27)         |
| Floor                                  |                              |                         | 44.5                       | 0.15                        | 6.675       | 75                           | 3337.5 (28)  |
| Walls                                  | 92.61                        | 14.6                    | 78.01                      | 0.25                        | 19.5        | 60                           | 4680.6 (29)  |
| Roof                                   | 44.5                         | 0                       | 44.5                       | 0.11                        | 4.89        | 9                            | 400.5 (30)   |
| Total area of elements, m <sup>2</sup> |                              |                         | 181.61                     |                             |             |                              | (31)         |
| Party wall                             |                              |                         | 43.12                      | 0                           | 0           | 70                           | 3018.4 (32)  |
| Internal wall **                       |                              |                         | 145.3                      |                             |             | 9                            | 1307.7 (32c) |
| Internal floor                         |                              |                         | 44.5                       |                             |             | 18                           | 801 (32d)    |
| Internal ceiling                       |                              |                         | 44.5                       |                             |             | 9                            | 400.5 (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) = 50.37 (33)

Heat capacity Cm = S(A x k) ((23) ... (30) + (32) + (32a) ... (32e) = 13946.2 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K = (34) ÷ (4) = 156.7 (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

7.49 (36)

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

Total fabric heat loss

(33) + (36) =

57.87 (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= | 45.28 | 44.75 | 44.21 | 41.54 | 41  | 38.33 | 38.33 | 37.79 | 39.4 | 41  | 42.07 | 43.14 |

(38)

Heat transfer coefficient, W/K

(39)m = (37) ÷ (38)m

|        |        |        |        |      |       |       |       |       |       |       |       |        |
|--------|--------|--------|--------|------|-------|-------|-------|-------|-------|-------|-------|--------|
| (39)m= | 103.15 | 102.62 | 102.08 | 99.4 | 98.87 | 96.19 | 96.19 | 95.66 | 97.26 | 98.87 | 99.94 | 101.01 |
|--------|--------|--------|--------|------|-------|-------|-------|-------|-------|-------|-------|--------|

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

99.27 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

|        |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| (40)m= | 1.16 | 1.15 | 1.15 | 1.12 | 1.11 | 1.08 | 1.08 | 1.07 | 1.09 | 1.11 | 1.12 | 1.13 |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|

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

1.12 (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

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

2.61

(42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

96.23

(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= | 105.85 | 102 | 98.15 | 94.31 | 90.46 | 86.61 | 86.61 | 90.46 | 94.31 | 98.15 | 102 | 105.85 |
|--------|--------|-----|-------|-------|-------|-------|-------|-------|-------|-------|-----|--------|

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

1154.76 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

|        |        |        |        |        |        |        |       |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|
| (45)m= | 156.98 | 137.29 | 141.67 | 123.51 | 118.52 | 102.27 | 94.77 | 108.75 | 110.05 | 128.25 | 139.99 | 152.02 |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|

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

1514.07 (45)

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

|        |       |       |       |       |       |       |       |       |       |       |    |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|------|
| (46)m= | 23.55 | 20.59 | 21.25 | 18.53 | 17.78 | 15.34 | 14.22 | 16.31 | 16.51 | 19.24 | 21 | 22.8 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|------|

(46)

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

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)

# SAP WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=

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

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m 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=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 14.13 | 12.75 | 14.09 | 13.59 | 14.01 | 13.53 | 13.95 | 13.99 | 13.56 | 14.06 | 13.65 | 14.12 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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=

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 171.11 | 150.05 | 155.76 | 137.11 | 132.53 | 115.8 | 108.72 | 122.74 | 123.61 | 142.31 | 153.64 | 166.14 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

(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=

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 171.11 | 150.05 | 155.76 | 137.11 | 132.53 | 115.8 | 108.72 | 122.74 | 123.61 | 142.31 | 153.64 | 166.14 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

Output from water heater (annual) × 1.12

1679.52

(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=

|       |       |       |       |       |       |    |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|----|-------|-------|-------|-------|-------|
| 55.73 | 48.84 | 50.63 | 44.47 | 42.91 | 37.39 | 35 | 39.66 | 39.98 | 46.16 | 49.96 | 54.08 |
|-------|-------|-------|-------|-------|-------|----|-------|-------|-------|-------|-------|

(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    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 156.71 | 156.71 | 156.71 | 156.71 | 156.71 | 156.71 | 156.71 | 156.71 | 156.71 | 156.71 | 156.71 | 156.71 |

(66)

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

(67)m=

|       |       |       |    |       |       |       |       |       |       |       |       |
|-------|-------|-------|----|-------|-------|-------|-------|-------|-------|-------|-------|
| 56.68 | 50.34 | 40.94 | 31 | 23.17 | 19.56 | 21.14 | 27.47 | 36.88 | 46.82 | 54.65 | 58.26 |
|-------|-------|-------|----|-------|-------|-------|-------|-------|-------|-------|-------|

(67)

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

(68)m=

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 354.07 | 357.74 | 348.48 | 328.77 | 303.89 | 280.51 | 264.89 | 261.21 | 270.47 | 290.18 | 315.06 | 338.45 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(68)

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

(69)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 53.28 | 53.28 | 53.28 | 53.28 | 53.28 | 53.28 | 53.28 | 53.28 | 53.28 | 53.28 | 53.28 | 53.28 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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=

|         |         |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

(71)

Water heating gains (Table 5)

(72)m=

|      |       |       |       |       |       |       |      |       |       |       |       |
|------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|
| 74.9 | 72.68 | 68.05 | 61.76 | 57.67 | 51.93 | 47.04 | 53.3 | 55.53 | 62.04 | 69.39 | 72.69 |
|------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|

(72)

Total internal gains =

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

(73)m=

|        |        |     |        |        |        |        |        |        |        |        |        |
|--------|--------|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 594.17 | 589.28 | 566 | 530.05 | 493.26 | 460.51 | 441.58 | 450.51 | 471.39 | 507.56 | 547.62 | 577.91 |
|--------|--------|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(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) |      |
|--------------|---------------------------|------|---|------------------------|---|------------------|---|----------------|---|----------------|---|--------------|------|
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 19.64            | x | 0.45           | x | 1.11           | = | 54.1         | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 38.42            | x | 0.45           | x | 1.11           | = | 105.84       | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 63.27            | x | 0.45           | x | 1.11           | = | 174.3        | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 92.28            | x | 0.45           | x | 1.11           | = | 254.2        | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 113.09           | x | 0.45           | x | 1.11           | = | 311.53       | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 115.77           | x | 0.45           | x | 1.11           | = | 318.91       | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 110.22           | x | 0.45           | x | 1.11           | = | 303.62       | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 94.68            | x | 0.45           | x | 1.11           | = | 260.8        | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 73.59            | x | 0.45           | x | 1.11           | = | 202.71       | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 45.59            | x | 0.45           | x | 1.11           | = | 125.58       | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 24.49            | x | 0.45           | x | 1.11           | = | 67.46        | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 16.15            | x | 0.45           | x | 1.11           | = | 44.49        | (76) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 19.64            | x | 0.45           | x | 1.11           | = | 30.96        | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 38.42            | x | 0.45           | x | 1.11           | = | 60.57        | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 63.27            | x | 0.45           | x | 1.11           | = | 99.75        | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 92.28            | x | 0.45           | x | 1.11           | = | 145.49       | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 113.09           | x | 0.45           | x | 1.11           | = | 178.3        | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 115.77           | x | 0.45           | x | 1.11           | = | 182.52       | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 110.22           | x | 0.45           | x | 1.11           | = | 173.77       | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 94.68            | x | 0.45           | x | 1.11           | = | 149.26       | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 73.59            | x | 0.45           | x | 1.11           | = | 116.02       | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 45.59            | x | 0.45           | x | 1.11           | = | 71.87        | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 24.49            | x | 0.45           | x | 1.11           | = | 38.61        | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 16.15            | x | 0.45           | x | 1.11           | = | 25.46        | (80) |

Solar gains in watts, calculated for each month

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

|        |       |        |        |        |        |        |        |        |        |        |        |       |      |
|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|------|
| (83)m= | 85.07 | 166.41 | 274.05 | 399.69 | 489.83 | 501.43 | 477.38 | 410.06 | 318.73 | 197.46 | 106.07 | 69.95 | (83) |
|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|------|

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

|        |        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| (84)m= | 679.24 | 755.69 | 840.05 | 929.74 | 983.09 | 961.94 | 918.96 | 860.57 | 790.13 | 705.02 | 653.69 | 647.86 | (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 | 0.96 | 0.94 | 0.87 | 0.76 | 0.59 | 0.45 | 0.49 | 0.72 | 0.9 | 0.96 | 0.98 | (86) |

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

|        |       |       |       |       |       |       |       |       |       |       |       |      |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|
| (87)m= | 19.42 | 19.62 | 19.96 | 20.41 | 20.73 | 20.93 | 20.98 | 20.97 | 20.84 | 20.41 | 19.86 | 19.4 | (87) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (88)m= | 19.95 | 19.96 | 19.96 | 19.99 | 19.99 | 20.02 | 20.02 | 20.02 | 20.01 | 19.99 | 19.98 | 19.97 | (88) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |      |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| (89)m= | 0.97 | 0.96 | 0.92 | 0.84 | 0.71 | 0.51 | 0.35 | 0.39 | 0.65 | 0.88 | 0.95 | 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=                    | 17.86 | 18.16 | 18.65 | 19.28 | 19.72 | 19.96 | 20.01 | 20.01 | 19.87 | 19.3 | 18.52 | 17.86 | (90) |
| fLA = Living area ÷ (4) = |       |       |       |       |       |       |       |       |       |      |       |       | (91) |
|                           |       |       |       |       |       |       |       |       |       |      | 0.18  |       |      |

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

|        |       |       |       |       |      |       |       |       |       |      |       |       |      |
|--------|-------|-------|-------|-------|------|-------|-------|-------|-------|------|-------|-------|------|
| (92)m= | 18.14 | 18.42 | 18.88 | 19.48 | 19.9 | 20.13 | 20.18 | 20.18 | 20.04 | 19.5 | 18.75 | 18.13 | (92) |
|--------|-------|-------|-------|-------|------|-------|-------|-------|-------|------|-------|-------|------|

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

|        |       |       |       |       |       |       |       |       |       |       |      |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|------|
| (93)m= | 17.99 | 18.27 | 18.73 | 19.33 | 19.75 | 19.98 | 20.03 | 20.03 | 19.89 | 19.35 | 18.6 | 17.98 | (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 | 0.9 | 0.82 | 0.69 | 0.51 | 0.35 | 0.39 | 0.64 | 0.86 | 0.94 | 0.96 | (94) |
|--------|------|------|-----|------|------|------|------|------|------|------|------|------|------|

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

|        |        |        |       |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| (95)m= | 651.06 | 710.96 | 758.7 | 765.29 | 682.21 | 491.71 | 324.93 | 339.65 | 503.96 | 603.02 | 613.39 | 624.34 | (95) |
|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

Monthly average external temperature from Table 8

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

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

|        |         |         |         |         |        |        |        |        |        |        |        |         |      |
|--------|---------|---------|---------|---------|--------|--------|--------|--------|--------|--------|--------|---------|------|
| (97)m= | 1412.19 | 1371.63 | 1248.67 | 1037.15 | 795.58 | 517.46 | 329.81 | 346.93 | 563.07 | 865.06 | 1149.8 | 1392.06 | (97) |
|--------|---------|---------|---------|---------|--------|--------|--------|--------|--------|--------|--------|---------|------|

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

|                                                         |        |        |        |        |       |   |   |   |   |        |         |        |      |
|---------------------------------------------------------|--------|--------|--------|--------|-------|---|---|---|---|--------|---------|--------|------|
| (98)m=                                                  | 566.27 | 443.97 | 364.54 | 195.74 | 84.35 | 0 | 0 | 0 | 0 | 194.96 | 386.21  | 571.19 | (98) |
| Total per year (kWh/year) = Sum(98) <sub>1...12</sub> = |        |        |        |        |       |   |   |   |   |        |         |        | (99) |
|                                                         |        |        |        |        |       |   |   |   |   |        | 2807.23 |        |      |

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

31.54 (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)

|        |        |        |        |       |   |   |   |   |        |        |        |
|--------|--------|--------|--------|-------|---|---|---|---|--------|--------|--------|
| 566.27 | 443.97 | 364.54 | 195.74 | 84.35 | 0 | 0 | 0 | 0 | 194.96 | 386.21 | 571.19 |
|--------|--------|--------|--------|-------|---|---|---|---|--------|--------|--------|

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

|        |        |        |        |      |   |   |   |   |        |        |        |
|--------|--------|--------|--------|------|---|---|---|---|--------|--------|--------|
| 625.72 | 490.57 | 402.81 | 216.28 | 93.2 | 0 | 0 | 0 | 0 | 215.42 | 426.76 | 631.15 |
|--------|--------|--------|--------|------|---|---|---|---|--------|--------|--------|

Total (kWh/year) = Sum(211)<sub>1...12</sub> = 3101.91 (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)

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 171.11 | 150.05 | 155.76 | 137.11 | 132.53 | 115.8 | 108.72 | 122.74 | 123.61 | 142.31 | 153.64 | 166.14 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

Efficiency of water heater 87.3 (216)

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|         |       |       |       |       |       |      |      |      |      |       |       |       |       |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|
| (217)m= | 89.74 | 89.67 | 89.52 | 89.15 | 88.52 | 87.3 | 87.3 | 87.3 | 87.3 | 89.12 | 89.57 | 89.76 | (217) |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

|                              |        |        |     |        |        |        |        |       |        |        |        |         |       |
|------------------------------|--------|--------|-----|--------|--------|--------|--------|-------|--------|--------|--------|---------|-------|
| (219)m=                      | 190.68 | 167.33 | 174 | 153.79 | 149.72 | 132.64 | 124.54 | 140.6 | 141.59 | 159.68 | 171.54 | 185.1   |       |
| Total = Sum(219a)...(219j) = |        |        |     |        |        |        |        |       |        |        |        | 1891.21 | (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

57.58 (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) = 132.58 (231)

Electricity for lighting

400.41 (232)

## 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                     | x 0.01 = 107.95 (240) |
| Space heating - main system 2                                                                                           | (213) x          | 0                        | x 0.01 = 0 (241)      |
| Space heating - secondary                                                                                               | (215) x          | 13.19                    | x 0.01 = 0 (242)      |
| Water heating cost (other fuel)                                                                                         | (219)            | 3.48                     | x 0.01 = 65.81 (247)  |
| Pumps, fans and electric keep-hot                                                                                       | (231)            | 13.19                    | x 0.01 = 17.49 (249)  |
| (if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a |                  |                          |                       |
| Energy for lighting                                                                                                     | (232)            | 13.19                    | x 0.01 = 52.81 (250)  |
| Additional standing charges (Table 12)                                                                                  |                  |                          | 120 (251)             |

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

**Total energy cost** (245)...(247) + (250)...(254) = 364.06 (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] = 1.14 (257) |
| <b>SAP rating (Section 12)</b>  | 84.08 (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                         | = 670.01 (261)           |
| Space heating (secondary)     | (215) x            | 0.519                         | = 0 (263)                |
| Water heating                 | (219) x            | 0.216                         | = 408.5 (264)            |

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|                                                   |                                 |       |   |         |       |
|---------------------------------------------------|---------------------------------|-------|---|---------|-------|
| Space and water heating                           | {261} + {262} + {263} + {264} = |       |   | 1078.51 | {265} |
| Electricity for pumps, fans and electric keep-hot | {231} x                         | 0.519 | = | 68.81   | {267} |
| Electricity for lighting                          | {232} x                         | 0.519 | = | 207.81  | {268} |
| Total CO2, kg/year                                | sum of {265} .. {271} =         |       |   | 1355.14 | {272} |
| <b>CO2 emissions per m²</b>                       | {272} ÷ (4) =                   |       |   | 15.23   | {273} |
| El rating (section 14)                            |                                 |       |   | 86      | {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              | = | 3784.33               | {261} |
| Space heating (secondary)                         | {215} x                         | 3.07              | = | 0                     | {263} |
| Energy for water heating                          | {219} x                         | 1.22              | = | 2307.28               | {264} |
| Space and water heating                           | {261} + {262} + {263} + {264} = |                   |   | 6091.61               | {265} |
| Electricity for pumps, fans and electric keep-hot | {231} x                         | 3.07              | = | 407.01                | {267} |
| Electricity for lighting                          | {232} x                         | 0                 | = | 1229.27               | {268} |
| 'Total Primary Energy                             | sum of {265}...{271} =          |                   |   | 7727.88               | {272} |
| <b>Primary energy kWh/m²/year</b>                 | {272} ÷ (4) =                   |                   |   | 86.83                 | {273} |

# DFEE 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 149

**Address :** Plot 149, The Hedgerows, Westergate, PO20

## 1. General dwelling dimensions

|                                                           | Area(m <sup>2</sup> ) |   | Av. Height(m)                      |   | Volume(m <sup>3</sup> ) |
|-----------------------------------------------------------|-----------------------|---|------------------------------------|---|-------------------------|
| Ground floor                                              | 44.5 (1a)             | x | 2.3 (2a)                           | = | 102.35 (3a)             |
| First floor                                               | 44.5 (1b)             | x | 2.6 (2b)                           | = | 115.7 (3b)              |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 89 (4)                |   |                                    |   |                         |
| Dwelling volume                                           |                       |   | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | = | 218.05 (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  |              |   |                   |   |       |   | 3     | x 10 = | 30 (7a)                 |
| Number of passive vents      |              |   |                   |   |       |   | 0     | x 10 = | 0 (7b)                  |
| Number of flueless gas fires |              |   |                   |   |       |   | 0     | x 40 = | 0 (7c)                  |

## Air changes per hour

|                                                                                                                                                        |                                          |               |           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------------|-----------|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =                                                                              | 30                                       | ÷ (5) =       | 0.14 (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)                                                               |                                          |               | 0.49 (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) =                     |               | 0.41 (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 |
|--------|-----|---|-----|-----|-----|-----|-----|-----|---|-----|-----|-----|

# DFEE 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

|  |      |      |      |      |      |      |      |      |      |      |      |      |
|--|------|------|------|------|------|------|------|------|------|------|------|------|
|  | 0.53 | 0.52 | 0.51 | 0.46 | 0.45 | 0.39 | 0.39 | 0.38 | 0.41 | 0.45 | 0.47 | 0.49 |
|--|------|------|------|------|------|------|------|------|------|------|------|------|

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

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

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

(24a)

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

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

(24b)

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

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

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

(24c)

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

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

|         |      |      |      |     |     |      |      |      |      |     |      |      |
|---------|------|------|------|-----|-----|------|------|------|------|-----|------|------|
| (24d)m= | 0.64 | 0.63 | 0.63 | 0.6 | 0.6 | 0.58 | 0.58 | 0.57 | 0.59 | 0.6 | 0.61 | 0.62 |
|---------|------|------|------|-----|-----|------|------|------|------|-----|------|------|

(24d)

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

|        |      |      |      |     |     |      |      |      |      |     |      |      |
|--------|------|------|------|-----|-----|------|------|------|------|-----|------|------|
| (25)m= | 0.64 | 0.63 | 0.63 | 0.6 | 0.6 | 0.58 | 0.58 | 0.57 | 0.59 | 0.6 | 0.61 | 0.62 |
|--------|------|------|------|-----|-----|------|------|------|------|-----|------|------|

(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                         |                              |                         | 4.55                       | $\times 1/[1/(1.4) + 0.04]$ | 6.03        |                              | (27)         |
| Windows Type 2                         |                              |                         | 7.95                       | $\times 1/[1/(1.4) + 0.04]$ | 10.54       |                              | (27)         |
| Floor                                  |                              |                         | 44.5                       | 0.15                        | 6.675       | 75                           | 3337.5 (28)  |
| Walls                                  | 92.61                        | 14.6                    | 78.01                      | 0.25                        | 19.5        | 60                           | 4680.6 (29)  |
| Roof                                   | 44.5                         | 0                       | 44.5                       | 0.11                        | 4.89        | 9                            | 400.5 (30)   |
| Total area of elements, m <sup>2</sup> |                              |                         | 181.61                     |                             |             |                              | (31)         |
| Party wall                             |                              |                         | 43.12                      | 0                           | 0           | 70                           | 3018.4 (32)  |
| Internal wall **                       |                              |                         | 145.3                      |                             |             | 9                            | 1307.7 (32c) |
| Internal floor                         |                              |                         | 44.5                       |                             |             | 18                           | 801 (32d)    |
| Internal ceiling                       |                              |                         | 44.5                       |                             |             | 9                            | 400.5 (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) = 50.37 (33)

Heat capacity Cm = S(A x k) ((23)...(30) + (32) + (32a)...(32e) = 13946.2 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K = (34) ÷ (4) = 156.7 (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.

# DFEE WorkSheet: New dwelling design stage

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

7.49 (36)

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

Total fabric heat loss

(39) + (36) =

57.87 (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= | 46.02 | 45.63 | 45.25 | 43.46 | 43.12 | 41.56 | 41.56 | 41.27 | 42.16 | 43.12 | 43.8 | 44.51 |

(38)

Heat transfer coefficient, W/K

(39)m = (37) ÷ (38)m

|        |        |       |        |        |        |       |       |       |        |        |        |        |
|--------|--------|-------|--------|--------|--------|-------|-------|-------|--------|--------|--------|--------|
| (39)m= | 103.89 | 103.5 | 103.12 | 101.32 | 100.99 | 99.42 | 99.42 | 99.13 | 100.03 | 100.99 | 101.67 | 102.38 |
|--------|--------|-------|--------|--------|--------|-------|-------|-------|--------|--------|--------|--------|

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

101.32 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

|        |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| (40)m= | 1.17 | 1.16 | 1.16 | 1.14 | 1.13 | 1.12 | 1.12 | 1.11 | 1.12 | 1.13 | 1.14 | 1.15 |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|

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

1.14 (40)

Number of days in month (Table 1a)

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

(41)

## 4. Water heating energy requirement

kWh/year

Assumed occupancy, N

2.61

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

96.23

(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= | 105.85 | 102 | 98.15 | 94.31 | 90.46 | 86.61 | 86.61 | 90.46 | 94.31 | 98.15 | 102 | 105.85 |
|--------|--------|-----|-------|-------|-------|-------|-------|-------|-------|-------|-----|--------|

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

1154.76 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

|        |        |        |        |        |        |        |       |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|
| (45)m= | 156.98 | 137.29 | 141.67 | 123.51 | 118.52 | 102.27 | 94.77 | 108.75 | 110.05 | 128.25 | 139.99 | 152.02 |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|

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

1514.07 (45)

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

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

(46)

Water storage loss:

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

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)

# DFEE WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=

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

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m 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=

|        |       |        |        |        |       |       |       |       |        |        |        |
|--------|-------|--------|--------|--------|-------|-------|-------|-------|--------|--------|--------|
| 133.43 | 116.7 | 120.42 | 104.99 | 100.74 | 86.93 | 80.55 | 92.44 | 93.54 | 109.01 | 118.99 | 129.22 |
|--------|-------|--------|--------|--------|-------|-------|-------|-------|--------|--------|--------|

(62)

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

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

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

(63)

Output from water heater

(64)m=

|        |       |        |        |        |       |       |       |       |        |        |        |
|--------|-------|--------|--------|--------|-------|-------|-------|-------|--------|--------|--------|
| 133.43 | 116.7 | 120.42 | 104.99 | 100.74 | 86.93 | 80.55 | 92.44 | 93.54 | 109.01 | 118.99 | 129.22 |
|--------|-------|--------|--------|--------|-------|-------|-------|-------|--------|--------|--------|

Output from water heater (annual) × 1.12

1286.96

(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=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 33.36 | 29.17 | 30.11 | 26.25 | 25.18 | 21.73 | 20.14 | 23.11 | 23.38 | 27.25 | 29.75 | 32.31 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 |

(66)

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

(67)m=

|       |       |       |      |      |      |      |       |       |       |       |      |
|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|------|
| 22.67 | 20.14 | 16.38 | 12.4 | 9.27 | 7.82 | 8.45 | 10.99 | 14.75 | 18.73 | 21.86 | 23.3 |
|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|------|

(67)

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

(68)m=

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 237.23 | 239.69 | 233.48 | 220.28 | 203.61 | 187.94 | 177.47 | 175.01 | 181.21 | 194.42 | 211.09 | 226.76 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(68)

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

(69)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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=

|         |         |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

(71)

Water heating gains (Table 5)

(72)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 44.84 | 43.41 | 40.46 | 36.45 | 33.85 | 30.18 | 27.07 | 31.06 | 32.48 | 36.63 | 41.32 | 43.42 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(72)

Total internal gains =

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

(73)m=

|        |        |       |        |       |        |        |        |        |        |        |        |
|--------|--------|-------|--------|-------|--------|--------|--------|--------|--------|--------|--------|
| 366.91 | 365.42 | 352.5 | 331.31 | 308.9 | 288.13 | 275.17 | 279.24 | 290.62 | 311.96 | 336.44 | 355.66 |
|--------|--------|-------|--------|-------|--------|--------|--------|--------|--------|--------|--------|

(73)

## 6. Solar gains

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

# DFEE WorkSheet: New dwelling design stage

| Orientation: | Access Factor<br>Table 6d |      |   | Area<br>m <sup>2</sup> |   | Flux<br>Table 6a |   | g_<br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|--------------|---------------------------|------|---|------------------------|---|------------------|---|----------------|---|----------------|---|--------------|------|
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 19.64            | x | 0.45           | x | 1.11           | = | 54.1         | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 38.42            | x | 0.45           | x | 1.11           | = | 105.84       | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 63.27            | x | 0.45           | x | 1.11           | = | 174.3        | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 92.28            | x | 0.45           | x | 1.11           | = | 254.2        | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 113.09           | x | 0.45           | x | 1.11           | = | 311.53       | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 115.77           | x | 0.45           | x | 1.11           | = | 318.91       | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 110.22           | x | 0.45           | x | 1.11           | = | 303.62       | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 94.68            | x | 0.45           | x | 1.11           | = | 260.8        | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 73.59            | x | 0.45           | x | 1.11           | = | 202.71       | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 45.59            | x | 0.45           | x | 1.11           | = | 125.58       | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 24.49            | x | 0.45           | x | 1.11           | = | 67.46        | (76) |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x | 16.15            | x | 0.45           | x | 1.11           | = | 44.49        | (76) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 19.64            | x | 0.45           | x | 1.11           | = | 30.96        | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 38.42            | x | 0.45           | x | 1.11           | = | 60.57        | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 63.27            | x | 0.45           | x | 1.11           | = | 99.75        | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 92.28            | x | 0.45           | x | 1.11           | = | 145.49       | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 113.09           | x | 0.45           | x | 1.11           | = | 178.3        | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 115.77           | x | 0.45           | x | 1.11           | = | 182.52       | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 110.22           | x | 0.45           | x | 1.11           | = | 173.77       | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 94.68            | x | 0.45           | x | 1.11           | = | 149.26       | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 73.59            | x | 0.45           | x | 1.11           | = | 116.02       | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 45.59            | x | 0.45           | x | 1.11           | = | 71.87        | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 24.49            | x | 0.45           | x | 1.11           | = | 38.61        | (80) |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x | 16.15            | x | 0.45           | x | 1.11           | = | 25.46        | (80) |

Solar gains in watts, calculated for each month

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

|        |       |        |        |        |        |        |        |        |        |        |        |       |      |
|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|------|
| (83)m= | 85.07 | 166.41 | 274.05 | 399.69 | 489.83 | 501.43 | 477.38 | 410.06 | 318.73 | 197.46 | 106.07 | 69.95 | (83) |
|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|------|

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

|        |        |        |        |     |        |        |        |       |        |        |        |        |      |
|--------|--------|--------|--------|-----|--------|--------|--------|-------|--------|--------|--------|--------|------|
| (84)m= | 451.98 | 531.83 | 626.55 | 731 | 798.74 | 789.56 | 752.55 | 689.3 | 609.35 | 509.41 | 442.51 | 425.61 | (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 | 0.97 | 0.93 | 0.84 | 0.69 | 0.54 | 0.6 | 0.83 | 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 | 19.3 | 19.68 | 20.18 | 20.6 | 20.86 | 20.96 | 20.94 | 20.72 | 20.16 | 19.54 | 19.06 | (87) |
|--------|-------|------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (88)m= | 19.95 | 19.95 | 19.95 | 19.97 | 19.97 | 19.99 | 19.99 | 19.99 | 19.98 | 19.97 | 19.97 | 19.96 | (88) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |      |      |      |      |     |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|-----|------|------|------|------|------|------|------|------|
| (89)m= | 0.99 | 0.98 | 0.97 | 0.91 | 0.8 | 0.61 | 0.43 | 0.49 | 0.77 | 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=                    | 18.19 | 18.41 | 18.78 | 19.29 | 19.67 | 19.91 | 19.97 | 19.96 | 19.8 | 19.27 | 18.66 | 18.18 | (90) |
| fLA = Living area ÷ (4) = |       |       |       |       |       |       |       |       |      |       |       |       | (91) |
| 0.18                      |       |       |       |       |       |       |       |       |      |       |       |       | (91) |

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (92)m= | 18.35 | 18.57 | 18.94 | 19.44 | 19.84 | 20.08 | 20.15 | 20.14 | 19.96 | 19.43 | 18.81 | 18.33 | (92) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (93)m= | 18.35 | 18.57 | 18.94 | 19.44 | 19.84 | 20.08 | 20.15 | 20.14 | 19.96 | 19.43 | 18.81 | 18.33 | (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 | 0.96 | 0.9 | 0.79 | 0.62 | 0.45 | 0.51 | 0.77 | 0.94 | 0.98 | 0.99 | (94) |
|--------|------|------|------|-----|------|------|------|------|------|------|------|------|------|

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

|        |        |        |        |        |        |        |        |       |       |       |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|-------|--------|--------|------|
| (95)m= | 446.71 | 520.82 | 599.48 | 657.96 | 632.26 | 490.44 | 339.92 | 351.1 | 467.1 | 477.1 | 434.06 | 421.57 | (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= | 1459.7 | 1414.37 | 1283.1 | 1068.37 | 821.86 | 544.73 | 352.56 | 370.49 | 586.47 | 891.8 | 1190.99 | 1447.04 | (97) |
|--------|--------|---------|--------|---------|--------|--------|--------|--------|--------|-------|---------|---------|------|

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

|                                       |        |        |        |        |        |   |   |   |   |        |        |        |      |
|---------------------------------------|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|------|
| (98)m=                                | 753.66 | 600.46 | 508.61 | 295.49 | 141.06 | 0 | 0 | 0 | 0 | 308.54 | 544.98 | 762.95 | (98) |
| Total per year (kWh/year) = Sum(98) = |        |        |        |        |        |   |   |   |   |        |        |        | (98) |
| 3915.77                               |        |        |        |        |        |   |   |   |   |        |        |        | (98) |

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

|    |      |
|----|------|
| 44 | (99) |
|----|------|

## 10. 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 | 934.58 | 735.73 | 753.42 | 0 | 0 | 0 | 0 | (100) |
|---------|---|---|---|---|---|--------|--------|--------|---|---|---|---|-------|

Utilisation factor for loss hm

|         |   |   |   |   |   |      |      |      |   |   |   |   |       |
|---------|---|---|---|---|---|------|------|------|---|---|---|---|-------|
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.82 | 0.88 | 0.85 | 0 | 0 | 0 | 0 | (101) |
|---------|---|---|---|---|---|------|------|------|---|---|---|---|-------|

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

|         |   |   |   |   |   |        |        |     |   |   |   |   |       |
|---------|---|---|---|---|---|--------|--------|-----|---|---|---|---|-------|
| (102)m= | 0 | 0 | 0 | 0 | 0 | 762.62 | 645.75 | 639 | 0 | 0 | 0 | 0 | (102) |
|---------|---|---|---|---|---|--------|--------|-----|---|---|---|---|-------|

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

|         |   |   |   |   |   |         |        |        |   |   |   |   |       |
|---------|---|---|---|---|---|---------|--------|--------|---|---|---|---|-------|
| (103)m= | 0 | 0 | 0 | 0 | 0 | 1021.86 | 976.59 | 904.56 | 0 | 0 | 0 | 0 | (103) |
|---------|---|---|---|---|---|---------|--------|--------|---|---|---|---|-------|

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

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

|                           |   |   |   |   |   |        |        |        |   |   |   |   |       |
|---------------------------|---|---|---|---|---|--------|--------|--------|---|---|---|---|-------|
| (104)m=                   | 0 | 0 | 0 | 0 | 0 | 186.65 | 246.14 | 197.58 | 0 | 0 | 0 | 0 | (104) |
| Total = Sum(104) =        |   |   |   |   |   |        |        |        |   |   |   |   | (104) |
| 630.37                    |   |   |   |   |   |        |        |        |   |   |   |   | (104) |
| Cooled fraction           |   |   |   |   |   |        |        |        |   |   |   |   | (105) |
| f C = cooled area ÷ (4) = |   |   |   |   |   |        |        |        |   |   |   |   | (105) |
| 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) = |   |   |   |   |   |      |      |      |   |   |   |   | (106) |
| 0                  |   |   |   |   |   |      |      |      |   |   |   |   | (106) |

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

|                    |   |   |   |   |   |       |       |      |   |   |   |   |       |
|--------------------|---|---|---|---|---|-------|-------|------|---|---|---|---|-------|
| (107)m=            | 0 | 0 | 0 | 0 | 0 | 46.66 | 61.54 | 49.4 | 0 | 0 | 0 | 0 | (107) |
| Total = Sum(107) = |   |   |   |   |   |       |       |      |   |   |   |   | (107) |
| 157.59             |   |   |   |   |   |       |       |      |   |   |   |   | (107) |

## DFEE WorkSheet: New dwelling design stage

|                                                                                        |                |                  |       |
|----------------------------------------------------------------------------------------|----------------|------------------|-------|
| Space cooling requirement in kWh/m <sup>2</sup> /year                                  | (107) ÷ (4) =  | <div>1.77</div>  | (108) |
| 91 Fabric Energy Efficiency, calculated only under special conditions, see section 1.5 |                |                  |       |
| Fabric Energy Efficiency                                                               | (99) + (108) = | <div>45.77</div> | (109) |

# DER WorkSheet: New dwelling design stage

## User Details

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

## Property Address: Plot 149

**Address :** Plot 149, The Hedgerows, Westergate, PO20

## 1. General dwelling dimensions

|                                                           | Area(m <sup>2</sup> ) |        | Av. Height(m) |                                      | Volume(m <sup>3</sup> ) |
|-----------------------------------------------------------|-----------------------|--------|---------------|--------------------------------------|-------------------------|
| Ground floor                                              | 44.5                  | (1a) x | 2.3           | (2a) =                               | 102.35 (3a)             |
| First floor                                               | 44.5                  | (1b) x | 2.6           | (2b) =                               | 115.7 (3b)              |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 89                    | (4)    |               |                                      |                         |
| Dwelling volume                                           |                       |        |               | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 218.05 (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 |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|

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= | 0.63 | 0.62 | 0.61 | 0.58 | 0.57 | 0.53 | 0.53 | 0.53 | 0.55 | 0.57 | 0.58 | 0.6 |
|---------|------|------|------|------|------|------|------|------|------|------|------|-----|

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

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

## 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        |                              |            |
| Windows Type 1                         |                              |                         | 4.55                       | $\times 1/[1/(1.4) + 0.04]$ | 6.03        |                              |            |
| Windows Type 2                         |                              |                         | 7.95                       | $\times 1/[1/(1.4) + 0.04]$ | 10.54       |                              |            |
| Floor                                  |                              |                         | 44.5                       | 0.15                        | 6.675       | 75                           | 3337.5     |
| Walls                                  | 92.61                        | 14.6                    | 78.01                      | 0.25                        | 19.5        | 60                           | 4680.6     |
| Roof                                   | 44.5                         | 0                       | 44.5                       | 0.11                        | 4.89        | 9                            | 400.5      |
| Total area of elements, m <sup>2</sup> |                              |                         | 181.61                     |                             |             |                              |            |
| Party wall                             |                              |                         | 43.12                      | 0                           | 0           | 70                           | 3018.4     |
| Internal wall **                       |                              |                         | 145.3                      |                             |             | 9                            | 1307.7     |
| Internal floor                         |                              |                         | 44.5                       |                             |             | 18                           | 801        |
| Internal ceiling                       |                              |                         | 44.5                       |                             |             | 9                            | 400.5      |

\* 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) = 50.37 (33)

Heat capacity Cm = S(A x k) ((23)...(30) + (32) + (32a)...(32e) = 13946.2 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K = (34) ÷ (4) = 156.7 (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

7.49 (36)

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

Total fabric heat loss

(33) + (36) =

57.87 (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= | 45.28 | 44.75 | 44.21 | 41.54 | 41  | 38.33 | 38.33 | 37.79 | 39.4 | 41  | 42.07 | 43.14 |

(38)

Heat transfer coefficient, W/K

(39)m = (37) ÷ (38)m

|        |        |        |        |      |       |       |       |       |       |       |       |        |
|--------|--------|--------|--------|------|-------|-------|-------|-------|-------|-------|-------|--------|
| (39)m= | 103.15 | 102.62 | 102.08 | 99.4 | 98.87 | 96.19 | 96.19 | 95.66 | 97.26 | 98.87 | 99.94 | 101.01 |
|--------|--------|--------|--------|------|-------|-------|-------|-------|-------|-------|-------|--------|

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

99.27 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

|        |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| (40)m= | 1.16 | 1.15 | 1.15 | 1.12 | 1.11 | 1.08 | 1.08 | 1.07 | 1.09 | 1.11 | 1.12 | 1.13 |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|

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

1.12 (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

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

2.61

(42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

96.23

(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= | 105.85 | 102 | 98.15 | 94.31 | 90.46 | 86.61 | 86.61 | 90.46 | 94.31 | 98.15 | 102 | 105.85 |
|--------|--------|-----|-------|-------|-------|-------|-------|-------|-------|-------|-----|--------|

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

1154.76 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

|        |        |        |        |        |        |        |       |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|
| (45)m= | 156.98 | 137.29 | 141.67 | 123.51 | 118.52 | 102.27 | 94.77 | 108.75 | 110.05 | 128.25 | 139.99 | 152.02 |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|

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

1514.07 (45)

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

|        |       |       |       |       |       |       |       |       |       |       |    |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|------|
| (46)m= | 23.55 | 20.59 | 21.25 | 18.53 | 17.78 | 15.34 | 14.22 | 16.31 | 16.51 | 19.24 | 21 | 22.8 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|------|

(46)

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

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=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 14.13 | 12.75 | 14.09 | 13.59 | 14.01 | 13.53 | 13.95 | 13.99 | 13.56 | 14.06 | 13.65 | 14.12 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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=

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 171.11 | 150.05 | 155.76 | 137.11 | 132.53 | 115.8 | 108.72 | 122.74 | 123.61 | 142.31 | 153.64 | 166.14 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

(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=

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 171.11 | 150.05 | 155.76 | 137.11 | 132.53 | 115.8 | 108.72 | 122.74 | 123.61 | 142.31 | 153.64 | 166.14 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

Output from water heater (annual) × 1.12

1679.52

(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=

|       |       |       |       |       |       |    |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|----|-------|-------|-------|-------|-------|
| 55.73 | 48.84 | 50.63 | 44.47 | 42.91 | 37.39 | 35 | 39.66 | 39.98 | 46.16 | 49.96 | 54.08 |
|-------|-------|-------|-------|-------|-------|----|-------|-------|-------|-------|-------|

(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    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 |

(66)

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

(67)m=

|       |       |       |      |      |      |      |       |       |       |       |      |
|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|------|
| 22.67 | 20.14 | 16.38 | 12.4 | 9.27 | 7.82 | 8.45 | 10.99 | 14.75 | 18.73 | 21.86 | 23.3 |
|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|------|

(67)

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

(68)m=

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 237.23 | 239.69 | 233.48 | 220.28 | 203.61 | 187.94 | 177.47 | 175.01 | 181.21 | 194.42 | 211.09 | 226.76 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(68)

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

(69)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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=

|         |         |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

(71)

Water heating gains (Table 5)

(72)m=

|      |       |       |       |       |       |       |      |       |       |       |       |
|------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|
| 74.9 | 72.68 | 68.05 | 61.76 | 57.67 | 51.93 | 47.04 | 53.3 | 55.53 | 62.04 | 69.39 | 72.69 |
|------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|

(72)

Total internal gains =

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

(73)m=

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 399.98 | 397.68 | 383.09 | 359.61 | 335.73 | 312.87 | 298.15 | 304.48 | 316.67 | 340.37 | 367.52 | 387.92 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(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) |  |
|--------------|---------------------------|------|---|------------------------|------------------|--------|---|----------------|---|------|----------------|--------|------|--------------|--|
| East         | 0.9x                      | 0.77 | x | 7.95                   | x                | 19.64  | x | 0.45           | x | 1.11 | =              | 54.1   | (76) |              |  |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x                | 38.42  | x | 0.45           | x | 1.11 | =              | 105.84 | (76) |              |  |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x                | 63.27  | x | 0.45           | x | 1.11 | =              | 174.3  | (76) |              |  |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x                | 92.28  | x | 0.45           | x | 1.11 | =              | 254.2  | (76) |              |  |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x                | 113.09 | x | 0.45           | x | 1.11 | =              | 311.53 | (76) |              |  |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x                | 115.77 | x | 0.45           | x | 1.11 | =              | 318.91 | (76) |              |  |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x                | 110.22 | x | 0.45           | x | 1.11 | =              | 303.62 | (76) |              |  |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x                | 94.68  | x | 0.45           | x | 1.11 | =              | 260.8  | (76) |              |  |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x                | 73.59  | x | 0.45           | x | 1.11 | =              | 202.71 | (76) |              |  |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x                | 45.59  | x | 0.45           | x | 1.11 | =              | 125.58 | (76) |              |  |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x                | 24.49  | x | 0.45           | x | 1.11 | =              | 67.46  | (76) |              |  |
| East         | 0.9x                      | 0.77 | x | 7.95                   | x                | 16.15  | x | 0.45           | x | 1.11 | =              | 44.49  | (76) |              |  |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x                | 19.64  | x | 0.45           | x | 1.11 | =              | 30.96  | (80) |              |  |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x                | 38.42  | x | 0.45           | x | 1.11 | =              | 60.57  | (80) |              |  |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x                | 63.27  | x | 0.45           | x | 1.11 | =              | 99.75  | (80) |              |  |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x                | 92.28  | x | 0.45           | x | 1.11 | =              | 145.49 | (80) |              |  |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x                | 113.09 | x | 0.45           | x | 1.11 | =              | 178.3  | (80) |              |  |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x                | 115.77 | x | 0.45           | x | 1.11 | =              | 182.52 | (80) |              |  |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x                | 110.22 | x | 0.45           | x | 1.11 | =              | 173.77 | (80) |              |  |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x                | 94.68  | x | 0.45           | x | 1.11 | =              | 149.26 | (80) |              |  |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x                | 73.59  | x | 0.45           | x | 1.11 | =              | 116.02 | (80) |              |  |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x                | 45.59  | x | 0.45           | x | 1.11 | =              | 71.87  | (80) |              |  |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x                | 24.49  | x | 0.45           | x | 1.11 | =              | 38.61  | (80) |              |  |
| West         | 0.9x                      | 0.77 | x | 4.55                   | x                | 16.15  | x | 0.45           | x | 1.11 | =              | 25.46  | (80) |              |  |

Solar gains in watts, calculated for each month

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

|        |       |        |        |        |        |        |        |        |        |        |        |       |      |
|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|------|
| (83)m= | 85.07 | 166.41 | 274.05 | 399.69 | 489.83 | 501.43 | 477.38 | 410.06 | 318.73 | 197.46 | 106.07 | 69.95 | (83) |
|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|------|

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

|        |        |        |        |       |        |       |        |        |       |        |        |        |      |
|--------|--------|--------|--------|-------|--------|-------|--------|--------|-------|--------|--------|--------|------|
| (84)m= | 485.05 | 564.09 | 657.14 | 759.3 | 825.56 | 814.3 | 775.53 | 714.54 | 635.4 | 537.82 | 473.58 | 457.88 | (84) |
|--------|--------|--------|--------|-------|--------|-------|--------|--------|-------|--------|--------|--------|------|

## 7. Mean internal temperature (heating season)

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

21 (85)

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

|        |      |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|        | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |      |
| (86)m= | 0.99 | 0.98 | 0.97 | 0.92 | 0.82 | 0.67 | 0.52 | 0.57 | 0.81 | 0.95 | 0.99 | 0.99 | (86) |

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (87)m= | 19.15 | 19.36 | 19.74 | 20.24 | 20.64 | 20.89 | 20.97 | 20.95 | 20.76 | 20.22 | 19.61 | 19.13 | (87) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (88)m= | 19.95 | 19.96 | 19.96 | 19.99 | 19.99 | 20.02 | 20.02 | 20.02 | 20.01 | 19.99 | 19.98 | 19.97 | (88) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |      |      |      |     |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|-----|------|------|------|------|------|------|------|------|------|
| (89)m= | 0.99 | 0.98 | 0.96 | 0.9 | 0.78 | 0.59 | 0.41 | 0.47 | 0.74 | 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=                    | 17.47 | 17.79 | 18.33 | 19.06 | 19.6 | 19.92 | 20 | 19.99 | 19.78 | 19.05 | 18.17 | 17.47 | (90) |
| fLA = Living area ÷ (4) = |       |       |       |       |      |       |    |       |       |       |       |       | (91) |
|                           |       |       |       |       |      |       |    |       |       |       | 0.18  |       |      |

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

|        |       |       |       |       |       |      |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|
| (92)m= | 17.77 | 18.07 | 18.58 | 19.27 | 19.79 | 20.1 | 20.17 | 20.16 | 19.95 | 19.26 | 18.42 | 17.76 | (92) |
|--------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |       |       |       |       |       |       |      |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|------|
| (93)m= | 17.62 | 17.92 | 18.43 | 19.12 | 19.64 | 19.95 | 20.02 | 20.01 | 19.8 | 19.11 | 18.27 | 17.61 | (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 | 0.94 | 0.88 | 0.76 | 0.58 | 0.41 | 0.47 | 0.73 | 0.92 | 0.97 | 0.99 | (94) |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|

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

|        |       |        |        |        |        |       |        |        |        |        |        |        |      |
|--------|-------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|------|
| (95)m= | 476.8 | 548.03 | 620.64 | 668.14 | 629.81 | 474.8 | 320.82 | 333.09 | 463.24 | 493.66 | 460.73 | 451.44 | (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= | 1373.82 | 1335.56 | 1217.9 | 1016.03 | 784.71 | 514.2 | 329 | 345.65 | 554.79 | 841.2 | 1116.63 | 1354.68 | (97) |
|--------|---------|---------|--------|---------|--------|-------|-----|--------|--------|-------|---------|---------|------|

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

|                                                         |        |        |        |        |        |   |   |   |   |        |         |        |      |
|---------------------------------------------------------|--------|--------|--------|--------|--------|---|---|---|---|--------|---------|--------|------|
| (98)m=                                                  | 667.38 | 529.22 | 444.36 | 250.48 | 115.25 | 0 | 0 | 0 | 0 | 258.57 | 472.25  | 672.01 | (98) |
| Total per year (kWh/year) = Sum(98) <sub>1...12</sub> = |        |        |        |        |        |   |   |   |   |        |         |        | (99) |
|                                                         |        |        |        |        |        |   |   |   |   |        | 3409.52 |        |      |

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

38.31 (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)

|        |        |        |        |        |   |   |   |   |        |        |        |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|
| 667.38 | 529.22 | 444.36 | 250.48 | 115.25 | 0 | 0 | 0 | 0 | 258.57 | 472.25 | 672.01 |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|

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

|        |        |        |        |        |   |   |   |   |        |        |        |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|
| 737.44 | 584.77 | 491.01 | 276.78 | 127.34 | 0 | 0 | 0 | 0 | 285.71 | 521.82 | 742.56 |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|

Total (kWh/year) = Sum(211)<sub>1...12</sub> = 3767.42 (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 | (215) |
| Total (kWh/year) = Sum(215) <sub>1...12</sub> = |   |   |   |   |   |   |   |   |   |   |   |       |
|                                                 |   |   |   |   |   |   |   |   |   |   | 0 |       |

### Water heating

Output from water heater (calculated above)

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 171.11 | 150.05 | 155.76 | 137.11 | 132.53 | 115.8 | 108.72 | 122.74 | 123.61 | 142.31 | 153.64 | 166.14 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

Efficiency of water heater 87.3 (216)

## DER WorkSheet: New dwelling design stage

|         |       |       |       |       |       |      |      |      |      |       |       |       |       |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|
| (217)m= | 89.83 | 89.77 | 89.65 | 89.34 | 88.76 | 87.3 | 87.3 | 87.3 | 87.3 | 89.34 | 89.69 | 89.85 | (217) |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

|                                         |        |        |        |        |        |        |        |       |        |        |       |         |       |
|-----------------------------------------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|-------|---------|-------|
| (219)m=                                 | 190.49 | 167.14 | 173.75 | 153.46 | 149.31 | 132.64 | 124.54 | 140.6 | 141.59 | 159.29 | 171.3 | 184.92  |       |
| Total = Sum{(219a)} <sub>i=1,12</sub> = |        |        |        |        |        |        |        |       |        |        |       | 1889.03 | (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

57.58 (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) =

132.58 (231)

Electricity for lighting

400.41 (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                         | 813.76 (261)             |
| Space heating (secondary)                         | (215) x                         | 0.519                         | 0 (263)                  |
| Water heating                                     | (219) x                         | 0.216                         | 408.03 (264)             |
| Space and water heating                           | (261) + (262) + (263) + (264) = |                               | 1221.79 (265)            |
| Electricity for pumps, fans and electric keep-hot | (231) x                         | 0.519                         | 68.81 (267)              |
| Electricity for lighting                          | (232) x                         | 0.519                         | 207.81 (268)             |
| Total CO2, kg/year                                |                                 | sum of (265)...(271) =        | 1498.41 (272)            |
| <b>Dwelling CO2 Emission Rate</b>                 |                                 | (272) ÷ (4) =                 | 16.84 (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 149

**Address :** Plot 149, The Hedgerows, Westergate, PO20

## 1. General dwelling dimensions

|                                                           | Area(m <sup>2</sup> ) |        | Av. Height(m) |                                      | Volume(m <sup>3</sup> ) |
|-----------------------------------------------------------|-----------------------|--------|---------------|--------------------------------------|-------------------------|
| Ground floor                                              | 44.5                  | (1a) x | 2.3           | (2a) =                               | 102.35 (3a)             |
| First floor                                               | 44.5                  | (1b) x | 2.6           | (2b) =                               | 115.7 (3b)              |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 89                    | (4)    |               |                                      |                         |
| Dwelling volume                                           |                       |        |               | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 218.05 (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  |              |   |                   |   |       |   | 3     | x 10 = | 30 (7a)                 |
| Number of passive vents      |              |   |                   |   |       |   | 0     | x 10 = | 0 (7b)                  |
| Number of flueless gas fires |              |   |                   |   |       |   | 0     | x 40 = | 0 (7c)                  |

## Air changes per hour

|                                                                                                                                                        |                                          |               |           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------------|-----------|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =                                                                              | 30                                       | ÷ (5) =       | 0.14 (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)                                                               |                                          |               | 0.39 (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) =                     |               | 0.33 (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

|  |      |      |     |      |      |      |      |     |      |      |      |      |
|--|------|------|-----|------|------|------|------|-----|------|------|------|------|
|  | 0.42 | 0.41 | 0.4 | 0.36 | 0.35 | 0.31 | 0.31 | 0.3 | 0.33 | 0.35 | 0.37 | 0.39 |
|--|------|------|-----|------|------|------|------|-----|------|------|------|------|

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × 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) × [1 – (23c) ÷ 100]

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

(24a)

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

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

(24b)

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

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

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

(24c)

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

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

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

(24d)

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

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

(25)

## 3. Thermal losses and heat capacity parameter

| ELEMENT                    | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m²K               | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K |
|----------------------------|-----------------|-------------|----------------|-----------------------------|-------------|-----------------|------------|
| Doors                      |                 |             | 2.1            | 1                           | 2.1         |                 | (26)       |
| Windows Type 1             |                 |             | 4.55           | $\times 1/[1/(1.4) + 0.04]$ | 6.03        |                 | (27)       |
| Windows Type 2             |                 |             | 7.95           | $\times 1/[1/(1.4) + 0.04]$ | 10.54       |                 | (27)       |
| Floor                      |                 |             | 44.5           | 0.13                        | 5.785       |                 | (28)       |
| Walls                      | 92.61           | 14.6        | 78.01          | 0.18                        | 14.04       |                 | (29)       |
| Roof                       | 44.5            | 0           | 44.5           | 0.13                        | 5.78        |                 | (30)       |
| Total area of elements, m² |                 |             | 181.61         |                             |             |                 | (31)       |
| Party wall                 |                 |             | 43.12          | 0                           | 0           |                 | (32)       |
| Internal wall **           |                 |             | 145.3          |                             |             |                 | (32c)      |
| Internal floor             |                 |             | 44.5           |                             |             |                 | (32d)      |
| Internal ceiling           |                 |             | 44.5           |                             |             |                 | (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) = 44.28 (33)

Heat capacity Cm = S(A x k) ((23) ... (30) + (32) + (32a) ... (32e) = 13946.2 (34)

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

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

# TER WorkSheet: New dwelling design stage

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

9.43 (36)

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

Total fabric heat loss

(39) + (36) =

53.71 (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= | 42.33 | 42.08 | 41.84 | 40.7 | 40.49 | 39.5 | 39.5 | 39.32 | 39.88 | 40.49 | 40.92 | 41.37 |

(38)

Heat transfer coefficient, W/K

(39)m = (37) ÷ (38)m

|        |       |       |       |       |      |       |       |       |       |      |       |       |
|--------|-------|-------|-------|-------|------|-------|-------|-------|-------|------|-------|-------|
| (39)m= | 96.04 | 95.79 | 95.55 | 94.41 | 94.2 | 93.21 | 93.21 | 93.03 | 93.59 | 94.2 | 94.63 | 95.08 |
|--------|-------|-------|-------|-------|------|-------|-------|-------|-------|------|-------|-------|

Average = Sum(39) / 12 =

94.41 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

|        |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| (40)m= | 1.08 | 1.08 | 1.07 | 1.06 | 1.06 | 1.05 | 1.05 | 1.05 | 1.05 | 1.06 | 1.06 | 1.07 |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|

Average = Sum(40) / 12 =

1.06 (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

2.61

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

96.23

(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= | 105.85 | 102 | 98.15 | 94.31 | 90.46 | 86.61 | 86.61 | 90.46 | 94.31 | 98.15 | 102 | 105.85 |
|--------|--------|-----|-------|-------|-------|-------|-------|-------|-------|-------|-----|--------|

Total = Sum(44) / 12 =

1154.76 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

|        |        |        |        |        |        |        |       |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|
| (45)m= | 156.98 | 137.29 | 141.67 | 123.51 | 118.52 | 102.27 | 94.77 | 108.75 | 110.05 | 128.25 | 139.99 | 152.02 |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|

Total = Sum(45) / 12 =

1514.07 (45)

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

|        |       |       |       |       |       |       |       |       |       |       |    |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|------|
| (46)m= | 23.55 | 20.59 | 21.25 | 18.53 | 17.78 | 15.34 | 14.22 | 16.31 | 16.51 | 19.24 | 21 | 22.8 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|------|

(46)

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

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 | 50.02 | 46.51 | 46.1 | 42.71 | 44.13 | 46.1 | 46.51 | 50.02 | 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=

|        |        |        |        |        |        |       |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|
| 207.94 | 183.32 | 191.69 | 170.02 | 164.61 | 144.98 | 138.9 | 154.84 | 156.55 | 178.27 | 189.31 | 202.98 |
|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|

(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=

|        |        |        |        |        |        |       |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|
| 207.94 | 183.32 | 191.69 | 170.02 | 164.61 | 144.98 | 138.9 | 154.84 | 156.55 | 178.27 | 189.31 | 202.98 |
|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|

Output from water heater (annual) × 1.12

2083.42

(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=

|       |       |       |      |       |       |       |       |       |       |       |       |
|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 64.93 | 57.16 | 59.61 | 52.7 | 50.93 | 44.68 | 42.54 | 47.68 | 48.22 | 55.15 | 58.88 | 63.29 |
|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|

(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

(66)m=

| Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 | 130.59 |

(66)

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

(67)m=

|       |       |       |      |      |      |      |       |       |       |       |      |
|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|------|
| 22.67 | 20.14 | 16.38 | 12.4 | 9.27 | 7.82 | 8.45 | 10.99 | 14.75 | 18.73 | 21.86 | 23.3 |
|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|------|

(67)

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

(68)m=

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 237.23 | 239.69 | 233.48 | 220.28 | 203.61 | 187.94 | 177.47 | 175.01 | 181.21 | 194.42 | 211.09 | 226.76 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(68)

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

(69)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 | 36.06 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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=

|         |         |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 | -104.47 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

(71)

Water heating gains (Table 5)

(72)m=

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 87.28 | 85.05 | 80.12 | 73.19 | 68.45 | 62.06 | 57.18 | 64.09 | 66.97 | 74.12 | 81.77 | 85.06 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(72)

Total internal gains =

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

(73)m=

|        |        |        |        |        |     |        |        |        |        |       |       |
|--------|--------|--------|--------|--------|-----|--------|--------|--------|--------|-------|-------|
| 412.35 | 410.06 | 395.16 | 371.04 | 346.51 | 323 | 308.29 | 315.27 | 328.11 | 352.45 | 379.9 | 400.3 |
|--------|--------|--------|--------|--------|-----|--------|--------|--------|--------|-------|-------|

(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_ <sub>u</sub><br>Table 6b |   | FF<br>Table 6c |   | Gains<br>(W) |      |
|--------------|------|---------------------------|---|------------------------|---|------------------|---|-----------------------------|---|----------------|---|--------------|------|
| East         | 0.9x | 0.77                      | x | 7.95                   | x | 19.64            | x | 0.63                        | x | 0.7            | = | 47.72        | (76) |
| East         | 0.9x | 0.77                      | x | 7.95                   | x | 38.42            | x | 0.63                        | x | 0.7            | = | 93.35        | (76) |
| East         | 0.9x | 0.77                      | x | 7.95                   | x | 63.27            | x | 0.63                        | x | 0.7            | = | 153.73       | (76) |
| East         | 0.9x | 0.77                      | x | 7.95                   | x | 92.28            | x | 0.63                        | x | 0.7            | = | 224.21       | (76) |
| East         | 0.9x | 0.77                      | x | 7.95                   | x | 113.09           | x | 0.63                        | x | 0.7            | = | 274.77       | (76) |
| East         | 0.9x | 0.77                      | x | 7.95                   | x | 115.77           | x | 0.63                        | x | 0.7            | = | 281.28       | (76) |
| East         | 0.9x | 0.77                      | x | 7.95                   | x | 110.22           | x | 0.63                        | x | 0.7            | = | 267.79       | (76) |
| East         | 0.9x | 0.77                      | x | 7.95                   | x | 94.68            | x | 0.63                        | x | 0.7            | = | 230.03       | (76) |
| East         | 0.9x | 0.77                      | x | 7.95                   | x | 73.59            | x | 0.63                        | x | 0.7            | = | 178.79       | (76) |
| East         | 0.9x | 0.77                      | x | 7.95                   | x | 45.59            | x | 0.63                        | x | 0.7            | = | 110.76       | (76) |
| East         | 0.9x | 0.77                      | x | 7.95                   | x | 24.49            | x | 0.63                        | x | 0.7            | = | 59.5         | (76) |
| East         | 0.9x | 0.77                      | x | 7.95                   | x | 16.15            | x | 0.63                        | x | 0.7            | = | 39.24        | (76) |
| West         | 0.9x | 0.77                      | x | 4.55                   | x | 19.64            | x | 0.63                        | x | 0.7            | = | 27.31        | (80) |
| West         | 0.9x | 0.77                      | x | 4.55                   | x | 38.42            | x | 0.63                        | x | 0.7            | = | 53.43        | (80) |
| West         | 0.9x | 0.77                      | x | 4.55                   | x | 63.27            | x | 0.63                        | x | 0.7            | = | 87.98        | (80) |
| West         | 0.9x | 0.77                      | x | 4.55                   | x | 92.28            | x | 0.63                        | x | 0.7            | = | 128.32       | (80) |
| West         | 0.9x | 0.77                      | x | 4.55                   | x | 113.09           | x | 0.63                        | x | 0.7            | = | 157.26       | (80) |
| West         | 0.9x | 0.77                      | x | 4.55                   | x | 115.77           | x | 0.63                        | x | 0.7            | = | 160.98       | (80) |
| West         | 0.9x | 0.77                      | x | 4.55                   | x | 110.22           | x | 0.63                        | x | 0.7            | = | 153.26       | (80) |
| West         | 0.9x | 0.77                      | x | 4.55                   | x | 94.68            | x | 0.63                        | x | 0.7            | = | 131.65       | (80) |
| West         | 0.9x | 0.77                      | x | 4.55                   | x | 73.59            | x | 0.63                        | x | 0.7            | = | 102.33       | (80) |
| West         | 0.9x | 0.77                      | x | 4.55                   | x | 45.59            | x | 0.63                        | x | 0.7            | = | 63.39        | (80) |
| West         | 0.9x | 0.77                      | x | 4.55                   | x | 24.49            | x | 0.63                        | x | 0.7            | = | 34.05        | (80) |
| West         | 0.9x | 0.77                      | x | 4.55                   | x | 16.15            | x | 0.63                        | x | 0.7            | = | 22.46        | (80) |

Solar gains in watts, calculated for each month

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

|        |       |        |        |        |        |        |        |        |        |        |       |      |      |
|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|------|------|
| (83)m= | 75.03 | 146.77 | 241.71 | 352.52 | 432.03 | 442.26 | 421.05 | 361.68 | 281.12 | 174.16 | 93.55 | 61.7 | (83) |
|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|------|------|

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

|        |        |        |        |        |        |        |        |        |        |        |        |     |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----|------|
| (84)m= | 487.38 | 556.83 | 636.87 | 723.57 | 778.54 | 765.26 | 729.34 | 676.94 | 609.23 | 526.61 | 473.45 | 462 | (84) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----|------|

## 7. Mean internal temperature (heating season)

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

21 (85)

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

|        |     |     |      |      |      |      |      |      |      |      |     |     |      |
|--------|-----|-----|------|------|------|------|------|------|------|------|-----|-----|------|
|        | Jan | Feb | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov | Dec |      |
| (86)m= | 1   | 1   | 0.99 | 0.97 | 0.89 | 0.72 | 0.55 | 0.61 | 0.87 | 0.98 | 1   | 1   | (86) |

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

|        |       |       |       |       |      |       |       |       |       |      |      |       |      |
|--------|-------|-------|-------|-------|------|-------|-------|-------|-------|------|------|-------|------|
| (87)m= | 19.81 | 19.94 | 20.19 | 20.52 | 20.8 | 20.95 | 20.99 | 20.99 | 20.87 | 20.5 | 20.1 | 19.78 | (87) |
|--------|-------|-------|-------|-------|------|-------|-------|-------|-------|------|------|-------|------|

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (88)m= | 20.02 | 20.02 | 20.02 | 20.03 | 20.03 | 20.04 | 20.04 | 20.05 | 20.04 | 20.03 | 20.03 | 20.03 | (88) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |   |   |      |      |      |      |      |     |     |      |   |   |      |
|--------|---|---|------|------|------|------|------|-----|-----|------|---|---|------|
| (89)m= | 1 | 1 | 0.99 | 0.95 | 0.85 | 0.64 | 0.44 | 0.5 | 0.8 | 0.97 | 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=                    | 18.42 | 18.62 | 18.98 | 19.47 | 19.84 | 20.01 | 20.04 | 20.04 | 19.94 | 19.44 | 18.85 | 18.39 | (90) |
| fLA = Living area ÷ (4) = |       |       |       |       |       |       |       |       |       |       |       |       | (91) |
|                           |       |       |       |       |       |       |       |       |       |       | 0.18  |       |      |

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

|        |       |       |      |       |       |       |       |       |      |       |       |       |      |
|--------|-------|-------|------|-------|-------|-------|-------|-------|------|-------|-------|-------|------|
| (92)m= | 18.66 | 18.86 | 19.2 | 19.65 | 20.01 | 20.18 | 20.21 | 20.21 | 20.1 | 19.63 | 19.07 | 18.64 | (92) |
|--------|-------|-------|------|-------|-------|-------|-------|-------|------|-------|-------|-------|------|

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

|        |       |       |      |       |       |       |       |       |      |       |       |       |      |
|--------|-------|-------|------|-------|-------|-------|-------|-------|------|-------|-------|-------|------|
| (93)m= | 18.66 | 18.86 | 19.2 | 19.65 | 20.01 | 20.18 | 20.21 | 20.21 | 20.1 | 19.63 | 19.07 | 18.64 | (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 | 0.99 | 0.98 | 0.95 | 0.85 | 0.65 | 0.46 | 0.52 | 0.81 | 0.97 | 0.99 | 1 | (94) |
|--------|---|------|------|------|------|------|------|------|------|------|------|---|------|

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

|        |       |        |        |        |        |       |       |       |        |        |        |        |      |
|--------|-------|--------|--------|--------|--------|-------|-------|-------|--------|--------|--------|--------|------|
| (95)m= | 486.1 | 553.69 | 626.84 | 685.36 | 658.12 | 497.7 | 333.7 | 349.1 | 492.04 | 510.63 | 470.86 | 461.08 | (95) |
|--------|-------|--------|--------|--------|--------|-------|-------|-------|--------|--------|--------|--------|------|

Monthly average external temperature from Table 8

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

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

|        |         |         |         |         |        |        |        |       |        |        |         |        |      |
|--------|---------|---------|---------|---------|--------|--------|--------|-------|--------|--------|---------|--------|------|
| (97)m= | 1379.38 | 1336.79 | 1213.32 | 1015.31 | 782.65 | 520.12 | 336.45 | 354.2 | 561.74 | 850.91 | 1132.86 | 1372.7 | (97) |
|--------|---------|---------|---------|---------|--------|--------|--------|-------|--------|--------|---------|--------|------|

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

|                                                         |       |        |        |        |       |   |   |   |   |        |         |        |      |
|---------------------------------------------------------|-------|--------|--------|--------|-------|---|---|---|---|--------|---------|--------|------|
| (98)m=                                                  | 664.6 | 526.24 | 436.34 | 237.56 | 92.65 | 0 | 0 | 0 | 0 | 253.17 | 476.64  | 678.25 | (98) |
| Total per year (kWh/year) = Sum(98) <sub>1...12</sub> = |       |        |        |        |       |   |   |   |   |        |         |        | (99) |
|                                                         |       |        |        |        |       |   |   |   |   |        | 3365.45 |        |      |

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

37.81 (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

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)

|       |        |        |        |       |   |   |   |   |        |        |        |
|-------|--------|--------|--------|-------|---|---|---|---|--------|--------|--------|
| 664.6 | 526.24 | 436.34 | 237.56 | 92.65 | 0 | 0 | 0 | 0 | 253.17 | 476.64 | 678.25 |
|-------|--------|--------|--------|-------|---|---|---|---|--------|--------|--------|

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

|        |        |        |        |      |   |   |   |   |        |        |        |
|--------|--------|--------|--------|------|---|---|---|---|--------|--------|--------|
| 711.57 | 563.43 | 467.17 | 254.35 | 99.2 | 0 | 0 | 0 | 0 | 271.06 | 510.32 | 726.18 |
|--------|--------|--------|--------|------|---|---|---|---|--------|--------|--------|

Total (kWh/year) = Sum(211)<sub>1...12</sub> = 3603.27 (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 | (215) |
| Total (kWh/year) = Sum(215) <sub>1...12</sub> = |   |   |   |   |   |   |   |   |   |   |   |       |
|                                                 |   |   |   |   |   |   |   |   |   |   | 0 |       |

### Water heating

Output from water heater (calculated above)

|        |        |        |        |        |        |       |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|
| 207.94 | 183.32 | 191.69 | 170.02 | 164.61 | 144.98 | 138.9 | 154.84 | 156.55 | 178.27 | 189.31 | 202.98 |
|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|

Efficiency of water heater 80.3 (216)

## TER WorkSheet: New dwelling design stage

|         |       |       |       |       |       |      |      |      |      |       |       |       |       |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|
| {217}m= | 87.77 | 87.55 | 87.06 | 85.89 | 83.67 | 80.3 | 80.3 | 80.3 | 80.3 | 85.93 | 87.28 | 87.85 | {217} |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|

Fuel for water heating, kWh/month

{219}m = {64}m x 100 ÷ {217}m

|                                          |        |        |        |        |        |        |        |        |        |        |       |         |       |
|------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|---------|-------|
| {219}m=                                  | 236.91 | 209.38 | 220.19 | 197.94 | 196.75 | 180.55 | 172.98 | 192.83 | 194.96 | 207.45 | 216.9 | 231.04  |       |
| Total = Sum({219a}) <sub>i=1..12</sub> = |        |        |        |        |        |        |        |        |        |        |       | 2457.88 | {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

400.41

{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                         | = | 778.31                   | {261} |
| Space heating (secondary)                         | {215} x                         | 0.519                         | = | 0                        | {263} |
| Water heating                                     | {219} x                         | 0.216                         | = | 530.9                    | {264} |
| Space and water heating                           | {261} + {262} + {263} + {264} = |                               |   | 1309.21                  | {265} |
| Electricity for pumps, fans and electric keep-hot | {231} x                         | 0.519                         | = | 38.93                    | {267} |
| Electricity for lighting                          | {232} x                         | 0.519                         | = | 207.81                   | {268} |
| Total CO2, kg/year                                | sum of {265}...{271} =          |                               |   | 1555.95                  | {272} |

TER =

17.48

{273}