

# Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.56  
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## Project Information:

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

**Building Type:** Detached House

## Dwelling Details:

### NEW DWELLING AS BUILT

Total Floor Area: 103m<sup>2</sup>

**Site Reference :** Stoneham Park

**Plot Reference:** Plot 304

**Address :** 39 Hopper Road, EASTLEIGH, SO50 9SH

## Client Details:

**Name:** Bargate Homes

**Address :** The New Barn, Vicarage Farm Business Park, Winchester Road, Fair Oak, SO50 7HD

**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) 17.95 kg/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 13.72 kg/m<sup>2</sup>

OK

## 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 57.9 kWh/m<sup>2</sup>

Dwelling Fabric Energy Efficiency (DFEE) 52.3 kWh/m<sup>2</sup>

OK

## 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.27 (max. 0.30) | 0.27 (max. 0.70) | OK |
| Floor         | 0.12 (max. 0.25) | 0.12 (max. 0.70) | OK |
| Roof          | 0.11 (max. 0.20) | 0.11 (max. 0.35) | OK |
| Openings      | 1.37 (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 | 4.36 |    |
| Maximum                        | 10.0 | OK |

## 4 Heating efficiency

|                           |                                                                                                                                                                                                                                                   |    |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Main Heating system:      | Database: (rev 505, 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: Programmer, room thermostat and TRVs **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 Summertime temperature

Overheating risk (South England): Slight **OK**

Based on:

Overshading: Average or unknown

Windows facing: East 9.45m<sup>2</sup>

Windows facing: West 13.5m<sup>2</sup>

Ventilation rate: 4.00

Blinds/curtains: None

## 10 Key features

Thermal bridging 0.035 W/m<sup>2</sup>K

Doors U-value 1 W/m<sup>2</sup>K

Roofs U-value 0.11 W/m<sup>2</sup>K

Floors U-value 0.12 W/m<sup>2</sup>K

Photovoltaic array

# SAP WorkSheet: New dwelling as built

## User Details:

**Assessor Name:** Gerard Mcguigan **Stroma Number:** STRO011196  
**Software Name:** Stroma FSAP 2012 **Software Version:** Version: 1.0.5.56

Property Address: Plot 304

**Address :** 39 Hopper Road, EASTLEIGH, SO50 9SH

## 1. Overall dwelling dimensions:

|                                                           | Area(m <sup>2</sup> ) | Av. Height(m)                        | Volume(m <sup>3</sup> ) |
|-----------------------------------------------------------|-----------------------|--------------------------------------|-------------------------|
| Ground floor                                              | 51.5 (1a) x           | 2.46 (2a) =                          | 126.69 (3a)             |
| First floor                                               | 51.5 (1b) x           | 2.54 (2b) =                          | 130.81 (3b)             |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 103 (4)               |                                      |                         |
| Dwelling volume                                           |                       | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 257.5 (5)               |

## 2. Ventilation rate:

|                              | main heating | secondary heating | other | total | m <sup>3</sup> per hour |
|------------------------------|--------------|-------------------|-------|-------|-------------------------|
| Number of chimneys           | 0            | 0                 | 0     | 0     | 0 (6a)                  |
| Number of open flues         | 0            | 0                 | 0     | 0     | 0 (6b)                  |
| Number of intermittent fans  |              |                   |       | 0     | 0 (7a)                  |
| Number of passive vents      |              |                   |       | 0     | 0 (7b)                  |
| Number of flueless gas fires |              |                   |       | 0     | 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                                                      |                                          |               | 4.3600001335144 (17) |
| If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)                                                               |                                          |               | 0.22 (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) =                     |               | 0.19 (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 as built

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

|  |      |      |      |     |     |      |      |      |      |     |      |      |
|--|------|------|------|-----|-----|------|------|------|------|-----|------|------|
|  | 0.24 | 0.23 | 0.23 | 0.2 | 0.2 | 0.18 | 0.18 | 0.17 | 0.19 | 0.2 | 0.21 | 0.22 |
|--|------|------|------|-----|-----|------|------|------|------|-----|------|------|

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

0 (23c)

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

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

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

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

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

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

|         |     |     |     |     |     |     |     |     |     |     |     |     |       |
|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| (24c)m= | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | (24c) |
|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|

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

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

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

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

|        |     |     |     |     |     |     |     |     |     |     |     |     |      |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| (25)m= | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | (25) |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|

## 3. Heat losses and heat loss parameter:

| ELEMENT                    | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m²K      | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K   |
|----------------------------|-----------------|-------------|----------------|--------------------|-------------|-----------------|--------------|
| Doors                      |                 |             | 2.1            | x 1                | = 2.1       |                 | (26)         |
| Windows Type 1             |                 |             | 9.45           | x 1/[1/(1.4)+0.04] | = 12.53     |                 | (27)         |
| Windows Type 2             |                 |             | 13.5           | x 1/[1/(1.4)+0.04] | = 17.9      |                 | (27)         |
| Floor                      |                 |             | 51.5           | x 0.12             | = 6.18      | 75              | 3862.5 (28)  |
| Walls                      | 150             | 25.05       | 124.95         | x 0.27             | = 33.74     | 150             | 18742.5 (29) |
| Roof                       | 51.5            | 0           | 51.5           | x 0.11             | = 5.66      | 9               | 463.5 (30)   |
| Total area of elements, m² |                 |             | 253            |                    |             |                 | (31)         |
| Internal wall **           |                 |             | 111.8          |                    |             | 9               | 1006.2 (32c) |
| Internal wall **           |                 |             | 50.4           |                    |             | 75              | 3780 (32c)   |
| Internal floor             |                 |             | 51.5           |                    |             | 18              | 927 (32d)    |
| Internal ceiling           |                 |             | 51.5           |                    |             | 9               | 463.5 (32e)  |

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 78.11 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 29245.2 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 283.93 (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.

# SAP WorkSheet: New dwelling as built

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

8.8 (36)

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

Total fabric heat loss

(33) + (36) =

86.9 (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= | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 |

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

|        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| (39)m= | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

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

129.39 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

|        |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| (40)m= | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|

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

1.26 (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

2.77

(42)

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

99.88

(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= | 109.87 | 105.88 | 101.88 | 97.89 | 93.89 | 89.9 | 89.9 | 93.89 | 97.89 | 101.88 | 105.88 | 109.87 |
|--------|--------|--------|--------|-------|-------|------|------|-------|-------|--------|--------|--------|

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

1198.6 (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= | 162.94 | 142.51 | 147.05 | 128.2 | 123.01 | 106.15 | 98.37 | 112.88 | 114.22 | 133.12 | 145.31 | 157.8 |
|--------|--------|--------|--------|-------|--------|--------|-------|--------|--------|--------|--------|-------|

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

1571.55 (45)

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

|        |       |       |       |       |       |       |       |       |       |       |      |       |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|
| (46)m= | 24.44 | 21.38 | 22.06 | 19.23 | 18.45 | 15.92 | 14.75 | 16.93 | 17.13 | 19.97 | 21.8 | 23.67 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|

(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 as built

Energy lost from water storage, kWh/year  $(47) \times (51) \times (52) \times (53) =$ 

|   |
|---|
| 0 |
| 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,  $(57)m = (56)m \times [(50) - (H11)] \div (50)$ , 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  $(59)m = (58) \div 365 \times (41)m$

(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  $(61)m = (60) \div 365 \times (41)m$

(61)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 14.15 | 12.77 | 14.11 | 13.61 | 14.03 | 13.54 | 13.97 | 14.01 | 13.58 | 14.08 | 13.66 | 14.14 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

 (61)

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

(62)m= 

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 177.08 | 155.27 | 161.16 | 141.82 | 137.05 | 119.69 | 112.33 | 126.89 | 127.81 | 147.19 | 158.97 | 171.93 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

 (62)

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

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

(63)m= 

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

 (63)

Output from water heater

(64)m= 

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 177.08 | 155.27 | 161.16 | 141.82 | 137.05 | 119.69 | 112.33 | 126.89 | 127.81 | 147.19 | 158.97 | 171.93 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

|                                                     |        |
|-----------------------------------------------------|--------|
| Output from water heater (annual) <sub>1...12</sub> | 1737.2 |
|-----------------------------------------------------|--------|

 (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= 

|       |       |       |       |       |       |      |       |       |       |       |    |
|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|----|
| 57.71 | 50.57 | 52.42 | 46.03 | 44.41 | 38.68 | 36.2 | 41.03 | 41.37 | 47.78 | 51.73 | 56 |
|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|----|

 (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    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 165.94 | 165.94 | 165.94 | 165.94 | 165.94 | 165.94 | 165.94 | 165.94 | 165.94 | 165.94 | 165.94 | 165.94 |

 (66)

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

(67)m= 

|       |       |       |       |       |       |      |       |       |       |      |       |
|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|------|-------|
| 58.19 | 51.68 | 42.03 | 31.82 | 23.79 | 20.08 | 21.7 | 28.21 | 37.86 | 48.07 | 56.1 | 59.81 |
|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|------|-------|

 (67)

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

(68)m= 

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 389.68 | 393.73 | 383.54 | 361.84 | 334.46 | 308.72 | 291.53 | 287.49 | 297.68 | 319.37 | 346.75 | 372.49 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

 (68)

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

(69)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 54.36 | 54.36 | 54.36 | 54.36 | 54.36 | 54.36 | 54.36 | 54.36 | 54.36 | 54.36 | 54.36 | 54.36 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

 (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= 

|         |         |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

 (71)

Water heating gains (Table 5)

(72)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 77.57 | 75.26 | 70.46 | 63.93 | 59.69 | 53.72 | 48.65 | 55.15 | 57.47 | 64.22 | 71.85 | 75.27 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

 (72)

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

(73)m= 

|        |        |       |        |        |       |        |        |        |        |        |        |
|--------|--------|-------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 638.12 | 633.34 | 608.7 | 570.27 | 530.61 | 495.2 | 474.56 | 483.52 | 505.67 | 544.33 | 587.38 | 620.24 |
|--------|--------|-------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

 (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 | 9.45                   | x                | 19.64  | x | 0.45           | x              | 1.11 | = | 64.31        | (76) |
| East         | 0.9x                      | 0.77 | x | 9.45                   | x                | 38.42  | x | 0.45           | x              | 1.11 | = | 125.81       | (76) |
| East         | 0.9x                      | 0.77 | x | 9.45                   | x                | 63.27  | x | 0.45           | x              | 1.11 | = | 207.18       | (76) |
| East         | 0.9x                      | 0.77 | x | 9.45                   | x                | 92.28  | x | 0.45           | x              | 1.11 | = | 302.16       | (76) |
| East         | 0.9x                      | 0.77 | x | 9.45                   | x                | 113.09 | x | 0.45           | x              | 1.11 | = | 370.31       | (76) |
| East         | 0.9x                      | 0.77 | x | 9.45                   | x                | 115.77 | x | 0.45           | x              | 1.11 | = | 379.08       | (76) |
| East         | 0.9x                      | 0.77 | x | 9.45                   | x                | 110.22 | x | 0.45           | x              | 1.11 | = | 360.9        | (76) |
| East         | 0.9x                      | 0.77 | x | 9.45                   | x                | 94.68  | x | 0.45           | x              | 1.11 | = | 310.01       | (76) |
| East         | 0.9x                      | 0.77 | x | 9.45                   | x                | 73.59  | x | 0.45           | x              | 1.11 | = | 240.96       | (76) |
| East         | 0.9x                      | 0.77 | x | 9.45                   | x                | 45.59  | x | 0.45           | x              | 1.11 | = | 149.28       | (76) |
| East         | 0.9x                      | 0.77 | x | 9.45                   | x                | 24.49  | x | 0.45           | x              | 1.11 | = | 80.19        | (76) |
| East         | 0.9x                      | 0.77 | x | 9.45                   | x                | 16.15  | x | 0.45           | x              | 1.11 | = | 52.89        | (76) |
| West         | 0.9x                      | 0.77 | x | 13.5                   | x                | 19.64  | x | 0.45           | x              | 1.11 | = | 91.87        | (80) |
| West         | 0.9x                      | 0.77 | x | 13.5                   | x                | 38.42  | x | 0.45           | x              | 1.11 | = | 179.72       | (80) |
| West         | 0.9x                      | 0.77 | x | 13.5                   | x                | 63.27  | x | 0.45           | x              | 1.11 | = | 295.98       | (80) |
| West         | 0.9x                      | 0.77 | x | 13.5                   | x                | 92.28  | x | 0.45           | x              | 1.11 | = | 431.66       | (80) |
| West         | 0.9x                      | 0.77 | x | 13.5                   | x                | 113.09 | x | 0.45           | x              | 1.11 | = | 529.02       | (80) |
| West         | 0.9x                      | 0.77 | x | 13.5                   | x                | 115.77 | x | 0.45           | x              | 1.11 | = | 541.55       | (80) |
| West         | 0.9x                      | 0.77 | x | 13.5                   | x                | 110.22 | x | 0.45           | x              | 1.11 | = | 515.57       | (80) |
| West         | 0.9x                      | 0.77 | x | 13.5                   | x                | 94.68  | x | 0.45           | x              | 1.11 | = | 442.87       | (80) |
| West         | 0.9x                      | 0.77 | x | 13.5                   | x                | 73.59  | x | 0.45           | x              | 1.11 | = | 344.23       | (80) |
| West         | 0.9x                      | 0.77 | x | 13.5                   | x                | 45.59  | x | 0.45           | x              | 1.11 | = | 213.25       | (80) |
| West         | 0.9x                      | 0.77 | x | 13.5                   | x                | 24.49  | x | 0.45           | x              | 1.11 | = | 114.55       | (80) |
| West         | 0.9x                      | 0.77 | x | 13.5                   | x                | 16.15  | x | 0.45           | x              | 1.11 | = | 75.55        | (80) |

Solar gains in watts, calculated for each month

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

(83)m= 156.18 305.53 503.16 733.83 899.33 920.63 876.47 752.88 585.19 362.53 194.74 128.44 (83)

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

(84)m= 794.3 938.87 1111.86 1304.1 1429.94 1415.83 1351.03 1236.4 1090.87 906.86 782.12 748.68 (84)

## 7. Mean internal temperature (heating season)

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

21 (85)

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

|        | Jan | Feb  | Mar  | Apr | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec |
|--------|-----|------|------|-----|------|------|------|------|------|------|------|-----|
| (86)m= | 1   | 0.99 | 0.97 | 0.9 | 0.76 | 0.57 | 0.42 | 0.48 | 0.74 | 0.95 | 0.99 | 1   |

(86)

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

(87)m= 19.89 20.07 20.36 20.69 20.9 20.98 21 20.99 20.93 20.61 20.17 19.85 (87)

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

(88)m= 19.88 19.88 19.88 19.88 19.88 19.88 19.88 19.88 19.88 19.88 19.88 19.88 (88)

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

|        | 1 | 0.99 | 0.96 | 0.87 | 0.69 | 0.48 | 0.31 | 0.36 | 0.65 | 0.93 | 0.99 | 1 |
|--------|---|------|------|------|------|------|------|------|------|------|------|---|
| (89)m= |   |      |      |      |      |      |      |      |      |      |      |   |

(89)

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (90)m= | 18.88 | 19.06 | 19.34 | 19.65 | 19.82 | 19.87 | 19.87 | 19.87 | 19.85 | 19.59 | 19.16 | 18.84 | (90) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

$$fLA = \text{Living area} \div (4) = 0.14 \quad (91)$$

Mean internal temperature (for the whole dwelling) =  $fLA \times T1 + (1 - fLA) \times T2$

|        |       |      |       |       |       |       |       |       |       |       |      |       |      |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|------|
| (92)m= | 19.02 | 19.2 | 19.48 | 19.79 | 19.97 | 20.02 | 20.03 | 20.03 | 19.99 | 19.73 | 19.3 | 18.98 | (92) |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|------|

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (93)m= | 18.87 | 19.05 | 19.33 | 19.64 | 19.82 | 19.87 | 19.88 | 19.88 | 19.84 | 19.58 | 19.15 | 18.83 | (93) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

## 8. Space heating requirement

Set  $T_i$  to the mean internal temperature obtained at step 11 of Table 9b, so that  $T_{i,m}=(76)m$  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,  $h_m$ :

|        |      |      |      |      |      |      |      |      |      |      |      |   |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|---|------|
| (94)m= | 0.99 | 0.98 | 0.95 | 0.86 | 0.69 | 0.48 | 0.31 | 0.36 | 0.65 | 0.92 | 0.99 | 1 | (94) |
|--------|------|------|------|------|------|------|------|------|------|------|------|---|------|

Useful gains,  $h_m G_m$ ,  $W = (94)m \times (84)m$

|        |        |        |         |         |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| (95)m= | 789.08 | 924.29 | 1061.71 | 1126.35 | 984.32 | 673.95 | 423.47 | 448.43 | 707.59 | 836.57 | 771.08 | 744.97 | (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,  $L_m$ ,  $W = [(39)m \times [(93)m - (96)m]]$

|        |        |         |         |        |         |        |        |        |        |         |         |         |      |
|--------|--------|---------|---------|--------|---------|--------|--------|--------|--------|---------|---------|---------|------|
| (97)m= | 1885.5 | 1830.37 | 1659.96 | 1389.5 | 1050.46 | 682.04 | 424.19 | 449.95 | 743.32 | 1161.57 | 1559.39 | 1892.42 | (97) |
|--------|--------|---------|---------|--------|---------|--------|--------|--------|--------|---------|---------|---------|------|

Space heating requirement for each month,  $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

|                                                          |        |        |       |        |       |   |   |   |   |       |        |         |      |
|----------------------------------------------------------|--------|--------|-------|--------|-------|---|---|---|---|-------|--------|---------|------|
| (98)m=                                                   | 815.73 | 608.88 | 445.1 | 189.47 | 49.21 | 0 | 0 | 0 | 0 | 241.8 | 567.58 | 853.7   |      |
| Total per year ( $kWh/year$ ) = $Sum(98)_{1..5,9..12} =$ |        |        |       |        |       |   |   |   |   |       |        | 3771.48 | (98) |

|                                             |       |      |
|---------------------------------------------|-------|------|
| Space heating requirement in $kWh/m^2/year$ | 36.62 | (99) |
|---------------------------------------------|-------|------|

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

### Space heating:

|                                                            |   |       |
|------------------------------------------------------------|---|-------|
| Fraction of space heat from secondary/supplementary system | 0 | (201) |
|------------------------------------------------------------|---|-------|

|                                            |                       |   |       |
|--------------------------------------------|-----------------------|---|-------|
| Fraction of space heat from main system(s) | (202) = $1 - (201) =$ | 1 | (202) |
|--------------------------------------------|-----------------------|---|-------|

|                                              |                                      |   |       |
|----------------------------------------------|--------------------------------------|---|-------|
| Fraction of total heating from main system 1 | (204) = $(202) \times [1 - (203)] =$ | 1 | (204) |
|----------------------------------------------|--------------------------------------|---|-------|

|                                           |      |       |
|-------------------------------------------|------|-------|
| Efficiency of main space heating system 1 | 90.5 | (206) |
|-------------------------------------------|------|-------|

|                                                         |   |       |
|---------------------------------------------------------|---|-------|
| Efficiency of secondary/supplementary heating system, % | 0 | (208) |
|---------------------------------------------------------|---|-------|

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

Space heating requirement (calculated above)

|        |        |       |        |       |   |   |   |   |       |        |       |
|--------|--------|-------|--------|-------|---|---|---|---|-------|--------|-------|
| 815.73 | 608.88 | 445.1 | 189.47 | 49.21 | 0 | 0 | 0 | 0 | 241.8 | 567.58 | 853.7 |
|--------|--------|-------|--------|-------|---|---|---|---|-------|--------|-------|

|                                                           |       |
|-----------------------------------------------------------|-------|
| (211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ | (211) |
|-----------------------------------------------------------|-------|

|        |       |        |        |       |   |   |   |   |        |        |        |
|--------|-------|--------|--------|-------|---|---|---|---|--------|--------|--------|
| 901.36 | 672.8 | 491.83 | 209.35 | 54.38 | 0 | 0 | 0 | 0 | 267.19 | 627.17 | 943.32 |
|--------|-------|--------|--------|-------|---|---|---|---|--------|--------|--------|

$$\text{Total } (kWh/year) = Sum(211)_{1..5,10..12} = 4167.38 \quad (211)$$

Space heating fuel (secondary),  $kWh/month$

=  $\{[(98)m \times (201)]\} \times 100 \div (208)$

|                                                     |   |   |   |   |   |   |   |   |   |   |   |   |       |
|-----------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|-------|
| (215)m=                                             | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |       |
| Total (kWh/year) =Sum(215) <sub>1..5,10..12</sub> = |   |   |   |   |   |   |   |   |   |   |   | 0 | (215) |

### Water heating

Output from water heater (calculated above)

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 177.08 | 155.27 | 161.16 | 141.82 | 137.05 | 119.69 | 112.33 | 126.89 | 127.81 | 147.19 | 158.97 | 171.93 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

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

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|         |       |       |       |      |       |      |      |      |      |       |       |       |       |
|---------|-------|-------|-------|------|-------|------|------|------|------|-------|-------|-------|-------|
| (217)m= | 89.91 | 89.83 | 89.63 | 89.1 | 88.12 | 87.3 | 87.3 | 87.3 | 87.3 | 89.26 | 89.78 | 89.95 | (217) |
|---------|-------|-------|-------|------|-------|------|------|------|------|-------|-------|-------|-------|

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

|                                       |        |        |        |        |        |        |        |        |       |       |        |         |       |
|---------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|--------|---------|-------|
| (219)m=                               | 196.95 | 172.85 | 179.82 | 159.16 | 155.52 | 137.11 | 128.68 | 145.35 | 146.4 | 164.9 | 177.07 | 191.15  |       |
| Total = Sum(219a) <sub>1...12</sub> = |        |        |        |        |        |        |        |        |       |       |        | 1954.94 | (219) |

## Annual totals

|                                                                              | kWh/year                 | kWh/year      |
|------------------------------------------------------------------------------|--------------------------|---------------|
| Space heating fuel used, main system 1                                       |                          | 4167.38       |
| Water heating fuel used                                                      |                          | 1954.94       |
| Electricity for pumps, fans and electric keep-hot                            |                          |               |
| mechanical ventilation - balanced, extract or positive input from outside    | 68.97                    | (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) = | 143.97 (231)  |
| Electricity for lighting                                                     |                          | 411.07 (232)  |
| Electricity generated by PVs                                                 |                          | -747.25 (233) |
| Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = |                          | 5930.12 (338) |

## 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 = 145.02 (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 = 68.03 (247)  |
| Pumps, fans and electric keep-hot                                                                                       | (231)                   | 13.19                    | x 0.01 = 18.99 (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 = 54.22 (250)  |
| Additional standing charges (Table 12)                                                                                  |                         |                          | 120 (251)             |
|                                                                                                                         | one of (233) to (235) x | 13.19                    | x 0.01 = -98.56 (252) |

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

|                          |                                 |             |
|--------------------------|---------------------------------|-------------|
| <b>Total energy cost</b> | (245)...(247) + (250)...(254) = | 307.7 (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] = 0.87 (257) |
| <b>SAP rating (Section 12)</b>  | 87.82 (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 |
|--------------------|-------------------------------|--------------------------|
|--------------------|-------------------------------|--------------------------|

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|                                                   |                                 |                        |   |         |       |
|---------------------------------------------------|---------------------------------|------------------------|---|---------|-------|
| Space heating (main system 1)                     | (211) x                         | 0.216                  | = | 900.16  | (261) |
| Space heating (secondary)                         | (215) x                         | 0.519                  | = | 0       | (263) |
| Water heating                                     | (219) x                         | 0.216                  | = | 422.27  | (264) |
| Space and water heating                           | (261) + (262) + (263) + (264) = |                        |   | 1322.42 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x                         | 0.519                  | = | 74.72   | (267) |
| Electricity for lighting                          | (232) x                         | 0.519                  | = | 213.35  | (268) |
| Energy saving/generation technologies<br>Item 1   |                                 | 0.519                  | = | -387.82 | (269) |
| Total CO <sub>2</sub> , kg/year                   |                                 | sum of (265)...(271) = |   | 1222.67 | (272) |
| <b>CO<sub>2</sub> emissions per m<sup>2</sup></b> |                                 | (272) ÷ (4) =          |   | 11.87   | (273) |
| El rating (section 14)                            |                                 |                        |   | 89      | (274) |

### 13a. Primary Energy

|                                                   | Energy<br>kWh/year              | Primary<br>factor      |   | P. Energy<br>kWh/year |       |
|---------------------------------------------------|---------------------------------|------------------------|---|-----------------------|-------|
| Space heating (main system 1)                     | (211) x                         | 1.22                   | = | 5084.21               | (261) |
| Space heating (secondary)                         | (215) x                         | 3.07                   | = | 0                     | (263) |
| Energy for water heating                          | (219) x                         | 1.22                   | = | 2385.03               | (264) |
| Space and water heating                           | (261) + (262) + (263) + (264) = |                        |   | 7469.24               | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x                         | 3.07                   | = | 442                   | (267) |
| Electricity for lighting                          | (232) x                         | 0                      | = | 1261.99               | (268) |
| Energy saving/generation technologies<br>Item 1   |                                 | 3.07                   | = | -2294.07              | (269) |
| 'Total Primary Energy                             |                                 | sum of (265)...(271) = |   | 6879.15               | (272) |
| <b>Primary energy kWh/m<sup>2</sup>/year</b>      |                                 | (272) ÷ (4) =          |   | 66.79                 | (273) |

# DER WorkSheet: New dwelling as built

## User Details:

**Assessor Name:** Gerard Mcguigan **Stroma Number:** STRO011196  
**Software Name:** Stroma FSAP 2012 **Software Version:** Version: 1.0.5.56

Property Address: Plot 304

**Address :** 39 Hopper Road, EASTLEIGH, SO50 9SH

## 1. Overall dwelling dimensions:

|                                                           | Area(m <sup>2</sup> ) |   | Av. Height(m) |                                      | Volume(m <sup>3</sup> ) |
|-----------------------------------------------------------|-----------------------|---|---------------|--------------------------------------|-------------------------|
| Ground floor                                              | 51.5 (1a)             | x | 2.46 (2a)     | =                                    | 126.69 (3a)             |
| First floor                                               | 51.5 (1b)             | x | 2.54 (2b)     | =                                    | 130.81 (3b)             |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 103 (4)               |   |               |                                      |                         |
| Dwelling volume                                           |                       |   |               | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 257.5 (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                                                      |                                          |               | 4.3600001335144 (17) |
| If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)                                                               |                                          |               | 0.22 (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) =                     |               | 0.19 (21)            |

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

|  |      |      |      |     |     |      |      |      |      |     |      |      |
|--|------|------|------|-----|-----|------|------|------|------|-----|------|------|
|  | 0.24 | 0.23 | 0.23 | 0.2 | 0.2 | 0.18 | 0.18 | 0.17 | 0.19 | 0.2 | 0.21 | 0.22 |
|--|------|------|------|-----|-----|------|------|------|------|-----|------|------|

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

0 (23c)

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

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

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

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

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

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

|         |     |     |     |     |     |     |     |     |     |     |     |     |       |
|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| (24c)m= | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | (24c) |
|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|

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

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

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

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

|        |     |     |     |     |     |     |     |     |     |     |     |     |      |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| (25)m= | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | (25) |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|

## 3. Heat losses and heat loss parameter:

| ELEMENT                    | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m²K      | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K   |
|----------------------------|-----------------|-------------|----------------|--------------------|-------------|-----------------|--------------|
| Doors                      |                 |             | 2.1            | x 1                | = 2.1       |                 | (26)         |
| Windows Type 1             |                 |             | 9.45           | x 1/[1/(1.4)+0.04] | = 12.53     |                 | (27)         |
| Windows Type 2             |                 |             | 13.5           | x 1/[1/(1.4)+0.04] | = 17.9      |                 | (27)         |
| Floor                      |                 |             | 51.5           | x 0.12             | = 6.18      | 75              | 3862.5 (28)  |
| Walls                      | 150             | 25.05       | 124.95         | x 0.27             | = 33.74     | 150             | 18742.5 (29) |
| Roof                       | 51.5            | 0           | 51.5           | x 0.11             | = 5.66      | 9               | 463.5 (30)   |
| Total area of elements, m² |                 |             | 253            |                    |             |                 | (31)         |
| Internal wall **           |                 |             | 111.8          |                    |             | 9               | 1006.2 (32c) |
| Internal wall **           |                 |             | 50.4           |                    |             | 75              | 3780 (32c)   |
| Internal floor             |                 |             | 51.5           |                    |             | 18              | 927 (32d)    |
| Internal ceiling           |                 |             | 51.5           |                    |             | 9               | 463.5 (32e)  |

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 78.11 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 29245.2 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 283.93 (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

8.8 (36)

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

Total fabric heat loss

(33) + (36) =

86.9 (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= | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 | 42.49 |

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

|        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| (39)m= | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 | 129.39 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

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

129.39 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

|        |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| (40)m= | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|

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

1.26 (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

2.77 (42)

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

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)

99.88 (43)

|  | 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= | 109.87 | 105.88 | 101.88 | 97.89 | 93.89 | 89.9 | 89.9 | 93.89 | 97.89 | 101.88 | 105.88 | 109.87 |
|--------|--------|--------|--------|-------|-------|------|------|-------|-------|--------|--------|--------|

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

1198.6 (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= | 162.94 | 142.51 | 147.05 | 128.2 | 123.01 | 106.15 | 98.37 | 112.88 | 114.22 | 133.12 | 145.31 | 157.8 |
|--------|--------|--------|--------|-------|--------|--------|-------|--------|--------|--------|--------|-------|

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

1571.55 (45)

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

|        |       |       |       |       |       |       |       |       |       |       |      |       |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|
| (46)m= | 24.44 | 21.38 | 22.06 | 19.23 | 18.45 | 15.92 | 14.75 | 16.93 | 17.13 | 19.97 | 21.8 | 23.67 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|

(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) × (51) × (52) × (53) =

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

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

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

(56)m= 

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

(56)

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

(57)m= 

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

(57)

Primary circuit loss (annual) from Table 3 

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

(58)

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

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

(59)m= 

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

(59)

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

(61)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 14.15 | 12.77 | 14.11 | 13.61 | 14.03 | 13.54 | 13.97 | 14.01 | 13.58 | 14.08 | 13.66 | 14.14 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(61)

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

(62)m= 

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 177.08 | 155.27 | 161.16 | 141.82 | 137.05 | 119.69 | 112.33 | 126.89 | 127.81 | 147.19 | 158.97 | 171.93 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(62)

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

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

(63)m= 

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

(63)

Output from water heater

(64)m= 

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 177.08 | 155.27 | 161.16 | 141.82 | 137.05 | 119.69 | 112.33 | 126.89 | 127.81 | 147.19 | 158.97 | 171.93 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(64)  
Output from water heater (annual)<sub>1...12</sub>

|        |
|--------|
| 1737.2 |
|--------|

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= 

|       |       |       |       |       |       |      |       |       |       |       |    |
|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|----|
| 57.71 | 50.57 | 52.42 | 46.03 | 44.41 | 38.68 | 36.2 | 41.03 | 41.37 | 47.78 | 51.73 | 56 |
|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|----|

(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    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 138.28 | 138.28 | 138.28 | 138.28 | 138.28 | 138.28 | 138.28 | 138.28 | 138.28 | 138.28 | 138.28 | 138.28 |

(66)

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

(67)m= 

|       |       |       |       |      |      |      |       |       |       |       |       |
|-------|-------|-------|-------|------|------|------|-------|-------|-------|-------|-------|
| 23.28 | 20.67 | 16.81 | 12.73 | 9.51 | 8.03 | 8.68 | 11.28 | 15.14 | 19.23 | 22.44 | 23.92 |
|-------|-------|-------|-------|------|------|------|-------|-------|-------|-------|-------|

(67)

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

(68)m= 

|        |       |        |        |        |        |        |        |        |        |        |        |
|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 261.09 | 263.8 | 256.97 | 242.44 | 224.09 | 206.84 | 195.32 | 192.62 | 199.44 | 213.98 | 232.32 | 249.57 |
|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(68)

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

(69)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 36.83 | 36.83 | 36.83 | 36.83 | 36.83 | 36.83 | 36.83 | 36.83 | 36.83 | 36.83 | 36.83 | 36.83 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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= 

|         |         |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

(71)

Water heating gains (Table 5)

(72)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 77.57 | 75.26 | 70.46 | 63.93 | 59.69 | 53.72 | 48.65 | 55.15 | 57.47 | 64.22 | 71.85 | 75.27 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(72)

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

(73)m= 

|        |        |        |        |        |        |        |        |        |        |       |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|
| 429.42 | 427.22 | 411.73 | 386.58 | 360.78 | 336.09 | 320.14 | 326.54 | 339.54 | 364.91 | 394.1 | 416.25 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|

(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 as built

| 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                      | 9.45                   | 19.64            | 0.45           | 1.11           | 64.31 (76)   |
| East         | 0.9x                      | 9.45                   | 38.42            | 0.45           | 1.11           | 125.81 (76)  |
| East         | 0.9x                      | 9.45                   | 63.27            | 0.45           | 1.11           | 207.18 (76)  |
| East         | 0.9x                      | 9.45                   | 92.28            | 0.45           | 1.11           | 302.16 (76)  |
| East         | 0.9x                      | 9.45                   | 113.09           | 0.45           | 1.11           | 370.31 (76)  |
| East         | 0.9x                      | 9.45                   | 115.77           | 0.45           | 1.11           | 379.08 (76)  |
| East         | 0.9x                      | 9.45                   | 110.22           | 0.45           | 1.11           | 360.9 (76)   |
| East         | 0.9x                      | 9.45                   | 94.68            | 0.45           | 1.11           | 310.01 (76)  |
| East         | 0.9x                      | 9.45                   | 73.59            | 0.45           | 1.11           | 240.96 (76)  |
| East         | 0.9x                      | 9.45                   | 45.59            | 0.45           | 1.11           | 149.28 (76)  |
| East         | 0.9x                      | 9.45                   | 24.49            | 0.45           | 1.11           | 80.19 (76)   |
| East         | 0.9x                      | 9.45                   | 16.15            | 0.45           | 1.11           | 52.89 (76)   |
| West         | 0.9x                      | 13.5                   | 19.64            | 0.45           | 1.11           | 91.87 (80)   |
| West         | 0.9x                      | 13.5                   | 38.42            | 0.45           | 1.11           | 179.72 (80)  |
| West         | 0.9x                      | 13.5                   | 63.27            | 0.45           | 1.11           | 295.98 (80)  |
| West         | 0.9x                      | 13.5                   | 92.28            | 0.45           | 1.11           | 431.66 (80)  |
| West         | 0.9x                      | 13.5                   | 113.09           | 0.45           | 1.11           | 529.02 (80)  |
| West         | 0.9x                      | 13.5                   | 115.77           | 0.45           | 1.11           | 541.55 (80)  |
| West         | 0.9x                      | 13.5                   | 110.22           | 0.45           | 1.11           | 515.57 (80)  |
| West         | 0.9x                      | 13.5                   | 94.68            | 0.45           | 1.11           | 442.87 (80)  |
| West         | 0.9x                      | 13.5                   | 73.59            | 0.45           | 1.11           | 344.23 (80)  |
| West         | 0.9x                      | 13.5                   | 45.59            | 0.45           | 1.11           | 213.25 (80)  |
| West         | 0.9x                      | 13.5                   | 24.49            | 0.45           | 1.11           | 114.55 (80)  |
| West         | 0.9x                      | 13.5                   | 16.15            | 0.45           | 1.11           | 75.55 (80)   |

Solar gains in watts, calculated for each month

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

(83)m= 156.18 305.53 503.16 733.83 899.33 920.63 876.47 752.88 585.19 362.53 194.74 128.44 (83)

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

(84)m= 585.6 732.74 914.89 1120.41 1260.11 1256.71 1196.62 1079.41 924.73 727.44 588.84 544.68 (84)

### 7. Mean internal temperature (heating season)

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

21 (85)

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

|        | Jan | Feb | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov | Dec |
|--------|-----|-----|------|------|------|------|------|------|------|------|-----|-----|
| (86)m= | 1   | 1   | 0.99 | 0.94 | 0.82 | 0.63 | 0.47 | 0.54 | 0.82 | 0.98 | 1   | 1   |

(86)

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

(87)m= 19.72 19.91 20.21 20.59 20.86 20.97 20.99 20.99 20.89 20.49 20.02 19.68 (87)

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

(88)m= 19.88 19.88 19.88 19.88 19.88 19.88 19.88 19.88 19.88 19.88 19.88 19.88 (88)

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

|        | Jan | Feb | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov | Dec |
|--------|-----|-----|------|------|------|------|------|------|------|------|-----|-----|
| (89)m= | 1   | 1   | 0.98 | 0.92 | 0.76 | 0.53 | 0.35 | 0.41 | 0.74 | 0.97 | 1   | 1   |

(89)

## DER WorkSheet: New dwelling as built

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

|        |       |      |      |       |       |       |       |       |       |       |       |       |      |
|--------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (90)m= | 18.72 | 18.9 | 19.2 | 19.56 | 19.79 | 19.86 | 19.87 | 19.87 | 19.82 | 19.47 | 19.01 | 18.67 | (90) |
|--------|-------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

|                           |      |      |
|---------------------------|------|------|
| fLA = Living area ÷ (4) = | 0.14 | (91) |
|---------------------------|------|------|

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

|        |       |       |       |      |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (92)m= | 18.86 | 19.04 | 19.34 | 19.7 | 19.94 | 20.02 | 20.03 | 20.03 | 19.97 | 19.61 | 19.15 | 18.81 | (92) |
|--------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |       |       |       |       |       |       |       |       |    |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|-------|------|
| (93)m= | 18.71 | 18.89 | 19.19 | 19.55 | 19.79 | 19.87 | 19.88 | 19.88 | 19.82 | 19.46 | 19 | 18.66 | (93) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|-------|------|

### 8. Space heating requirement

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

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

Utilisation factor for gains, hm:

|        |   |      |      |      |      |      |      |      |      |      |   |   |      |
|--------|---|------|------|------|------|------|------|------|------|------|---|---|------|
| (94)m= | 1 | 0.99 | 0.98 | 0.91 | 0.75 | 0.53 | 0.35 | 0.41 | 0.73 | 0.96 | 1 | 1 | (94) |
|--------|---|------|------|------|------|------|------|------|------|------|---|---|------|

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

|        |        |        |        |         |        |        |        |        |       |        |        |        |      |
|--------|--------|--------|--------|---------|--------|--------|--------|--------|-------|--------|--------|--------|------|
| (95)m= | 584.61 | 728.71 | 894.83 | 1021.24 | 947.37 | 668.02 | 422.84 | 446.94 | 677.8 | 700.74 | 586.35 | 544.04 | (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= | 1863.96 | 1809.64 | 1642.04 | 1378.11 | 1046.5 | 681.37 | 424.1 | 449.75 | 740.04 | 1146.85 | 1539.83 | 1871.29 | (97) |
|--------|---------|---------|---------|---------|--------|--------|-------|--------|--------|---------|---------|---------|------|

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

|                                                               |        |        |        |        |       |   |   |   |   |       |        |        |         |      |
|---------------------------------------------------------------|--------|--------|--------|--------|-------|---|---|---|---|-------|--------|--------|---------|------|
| (98)m=                                                        | 951.84 | 726.38 | 555.92 | 256.95 | 73.75 | 0 | 0 | 0 | 0 | 331.9 | 686.51 | 987.47 |         |      |
| Total per year (kWh/year) = Sum(98) <sub>1...5,9...12</sub> = |        |        |        |        |       |   |   |   |   |       |        |        | 4570.72 | (98) |

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

|       |      |
|-------|------|
| 44.38 | (99) |
|-------|------|

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

#### Space heating:

Fraction of space heat from secondary/supplementary system

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

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

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

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

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

Efficiency of main space heating system 1

|      |       |
|------|-------|
| 90.5 | (206) |
|------|-------|

Efficiency of secondary/supplementary heating system, %

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

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

kWh/year

Space heating requirement (calculated above)

|        |        |        |        |       |   |   |   |   |       |        |        |
|--------|--------|--------|--------|-------|---|---|---|---|-------|--------|--------|
| 951.84 | 726.38 | 555.92 | 256.95 | 73.75 | 0 | 0 | 0 | 0 | 331.9 | 686.51 | 987.47 |
|--------|--------|--------|--------|-------|---|---|---|---|-------|--------|--------|

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

|         |        |        |        |       |   |   |   |   |        |        |         |
|---------|--------|--------|--------|-------|---|---|---|---|--------|--------|---------|
| 1051.75 | 802.63 | 614.28 | 283.92 | 81.49 | 0 | 0 | 0 | 0 | 366.75 | 758.57 | 1091.13 |
|---------|--------|--------|--------|-------|---|---|---|---|--------|--------|---------|

$$\text{Total (kWh/year) = Sum(211)}_{1...5,10...12} = 5050.52 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

|                                                       |   |   |   |   |   |   |   |   |   |   |   |   |       |
|-------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|-------|
| (215)m=                                               | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |       |
| Total (kWh/year) =Sum(215) <sub>1...5,10...12</sub> = |   |   |   |   |   |   |   |   |   |   |   | 0 | (215) |

#### Water heating

Output from water heater (calculated above)

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 177.08 | 155.27 | 161.16 | 141.82 | 137.05 | 119.69 | 112.33 | 126.89 | 127.81 | 147.19 | 158.97 | 171.93 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

Efficiency of water heater

|      |       |
|------|-------|
| 87.3 | (216) |
|------|-------|

## DER WorkSheet: New dwelling as built

|         |       |       |       |       |       |      |      |      |      |       |       |       |       |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|
| (217)m= | 89.98 | 89.92 | 89.76 | 89.34 | 88.39 | 87.3 | 87.3 | 87.3 | 87.3 | 89.49 | 89.88 | 90.01 | (217) |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

|                                       |       |        |        |        |        |        |        |        |       |        |        |        |       |
|---------------------------------------|-------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|-------|
| (219)m=                               | 196.8 | 172.68 | 179.55 | 158.75 | 155.04 | 137.11 | 128.68 | 145.35 | 146.4 | 164.48 | 176.87 | 191.01 |       |
| Total = Sum(219a) <sub>1...12</sub> = |       |        |        |        |        |        |        |        |       |        |        | 1952.7 | (219) |

### Annual totals

|                                                                              | kWh/year                 | kWh/year      |
|------------------------------------------------------------------------------|--------------------------|---------------|
| Space heating fuel used, main system 1                                       |                          | 5050.52       |
| Water heating fuel used                                                      |                          | 1952.7        |
| Electricity for pumps, fans and electric keep-hot                            |                          |               |
| mechanical ventilation - balanced, extract or positive input from outside    | 68.97                    | (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) = | 143.97 (231)  |
| Electricity for lighting                                                     |                          | 411.07 (232)  |
| Electricity generated by PVs                                                 |                          | -747.25 (233) |
| Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = |                          | 6811.01 (338) |

### 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                         | = 1090.91 (261)          |
| Space heating (secondary)                         | (215) x                         | 0.519                         | = 0 (263)                |
| Water heating                                     | (219) x                         | 0.216                         | = 421.78 (264)           |
| Space and water heating                           | (261) + (262) + (263) + (264) = |                               | 1512.7 (265)             |
| Electricity for pumps, fans and electric keep-hot | (231) x                         | 0.519                         | = 74.72 (267)            |
| Electricity for lighting                          | (232) x                         | 0.519                         | = 213.35 (268)           |
| Energy saving/generation technologies<br>Item 1   |                                 | 0.519                         | = -387.82 (269)          |
| Total CO2, kg/year                                |                                 | sum of (265)...(271) =        | 1412.94 (272)            |
| Dwelling CO2 Emission Rate                        |                                 | (272) ÷ (4) =                 | 13.72 (273)              |
| EI rating (section 14)                            |                                 |                               | 87 (274)                 |

# TER WorkSheet: New dwelling as built

## User Details:

**Assessor Name:** Gerard Mcguigan **Stroma Number:** STRO011196  
**Software Name:** Stroma FSAP 2012 **Software Version:** Version: 1.0.5.56

Property Address: Plot 304

**Address :** 39 Hopper Road, EASTLEIGH, SO50 9SH

## 1. Overall dwelling dimensions:

|                                                           | Area(m <sup>2</sup> ) |   | Av. Height(m) |                                      | Volume(m <sup>3</sup> ) |
|-----------------------------------------------------------|-----------------------|---|---------------|--------------------------------------|-------------------------|
| Ground floor                                              | 51.5 (1a)             | x | 2.46 (2a)     | =                                    | 126.69 (3a)             |
| First floor                                               | 51.5 (1b)             | x | 2.54 (2b)     | =                                    | 130.81 (3b)             |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 103 (4)               |   |               |                                      |                         |
| Dwelling volume                                           |                       |   |               | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 257.5 (5)               |

## 2. Ventilation rate:

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

## Air changes per hour

|                                                                                                                                                        |                                          |               |           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------------|-----------|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =                                                                              | 40                                       | ÷ (5) =       | 0.16 (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)                                                               |                                          |               | 0.41 (18) |
| <i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>                                |                                          |               |           |
| Number of sides sheltered                                                                                                                              |                                          |               | 2 (19)    |
| Shelter factor                                                                                                                                         | (20) = 1 - [0.075 x (19)] =              |               | 0.85 (20) |
| Infiltration rate incorporating shelter factor                                                                                                         | (21) = (18) x (20) =                     |               | 0.34 (21) |

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

# TER WorkSheet: New dwelling as built

Wind Factor (22a)m = (22)m ÷ 4

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

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

|  |      |      |      |      |      |      |      |      |      |      |      |     |
|--|------|------|------|------|------|------|------|------|------|------|------|-----|
|  | 0.44 | 0.43 | 0.42 | 0.38 | 0.37 | 0.33 | 0.33 | 0.32 | 0.34 | 0.37 | 0.39 | 0.4 |
|--|------|------|------|------|------|------|------|------|------|------|------|-----|

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × 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= | 0.6 | 0.59 | 0.59 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.58 | 0.58 |
|---------|-----|------|------|------|------|------|------|------|------|------|------|------|

(24d)

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

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

(25)

## 3. Heat losses and heat loss parameter:

| ELEMENT                    | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m²K      | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K |
|----------------------------|-----------------|-------------|----------------|--------------------|-------------|-----------------|------------|
| Doors                      |                 |             | 2.1            | x 1                | = 2.1       |                 | (26)       |
| Windows Type 1             |                 |             | 9.45           | x 1/[1/(1.4)+0.04] | = 12.53     |                 | (27)       |
| Windows Type 2             |                 |             | 13.5           | x 1/[1/(1.4)+0.04] | = 17.9      |                 | (27)       |
| Floor                      |                 |             | 51.5           | x 0.13             | = 6.695     |                 | (28)       |
| Walls                      | 150             | 25.05       | 124.95         | x 0.18             | = 22.49     |                 | (29)       |
| Roof                       | 51.5            | 0           | 51.5           | x 0.13             | = 6.69      |                 | (30)       |
| Total area of elements, m² |                 |             | 253            |                    |             |                 | (31)       |
| Internal wall **           |                 |             | 111.8          |                    |             |                 | (32c)      |
| Internal wall **           |                 |             | 50.4           |                    |             |                 | (32c)      |
| Internal floor             |                 |             | 51.5           |                    |             |                 | (32d)      |
| Internal ceiling           |                 |             | 51.5           |                    |             |                 | (32e)      |

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 68.41 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 29245.2 (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.

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

11.55 (36)

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

Total fabric heat loss

(33) + (36) =

79.96 (37)

Ventilation heat loss calculated monthly

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

|        | Jan   | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug  | Sep   | Oct   | Nov   | Dec   |
|--------|-------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|
| (38)m= | 50.69 | 50.37 | 50.06 | 48.59 | 48.32 | 47.04 | 47.04 | 46.8 | 47.53 | 48.32 | 48.87 | 49.45 |

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

|        |        |        |        |        |        |     |     |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|-----|-----|--------|--------|--------|--------|--------|
| (39)m= | 130.64 | 130.33 | 130.01 | 128.55 | 128.27 | 127 | 127 | 126.76 | 127.49 | 128.27 | 128.83 | 129.41 |
|--------|--------|--------|--------|--------|--------|-----|-----|--------|--------|--------|--------|--------|

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

128.55 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

|        |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| (40)m= | 1.27 | 1.27 | 1.26 | 1.25 | 1.25 | 1.23 | 1.23 | 1.23 | 1.24 | 1.25 | 1.25 | 1.26 |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|

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

1.25 (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

2.77

(42)

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

99.88

(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= | 109.87 | 105.88 | 101.88 | 97.89 | 93.89 | 89.9 | 89.9 | 93.89 | 97.89 | 101.88 | 105.88 | 109.87 |
|--------|--------|--------|--------|-------|-------|------|------|-------|-------|--------|--------|--------|

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

1198.6 (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= | 162.94 | 142.51 | 147.05 | 128.2 | 123.01 | 106.15 | 98.37 | 112.88 | 114.22 | 133.12 | 145.31 | 157.8 |
|--------|--------|--------|--------|-------|--------|--------|-------|--------|--------|--------|--------|-------|

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

1571.55 (45)

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

|        |       |       |       |       |       |       |       |       |       |       |      |       |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|
| (46)m= | 24.44 | 21.38 | 22.06 | 19.23 | 18.45 | 15.92 | 14.75 | 16.93 | 17.13 | 19.97 | 21.8 | 23.67 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|

(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) × (51) × (52) × (53) =

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

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

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

(56)m= 

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

(56)

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

(57)m= 

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

(57)

Primary circuit loss (annual) from Table 3 

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

(58)

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

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

(59)m= 

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

(59)

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

(61)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 50.96 | 46.03 | 50.96 | 48.27 | 47.85 | 44.33 | 45.81 | 47.85 | 48.27 | 50.96 | 49.32 | 50.96 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(61)

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

(62)m= 

|       |        |        |        |        |        |        |        |       |        |        |        |
|-------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|
| 213.9 | 188.53 | 198.01 | 176.48 | 170.86 | 150.48 | 144.18 | 160.72 | 162.5 | 184.08 | 194.62 | 208.75 |
|-------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|

(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= 

|       |        |        |        |        |        |        |        |       |        |        |        |
|-------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|
| 213.9 | 188.53 | 198.01 | 176.48 | 170.86 | 150.48 | 144.18 | 160.72 | 162.5 | 184.08 | 194.62 | 208.75 |
|-------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|

(64)  
Output from water heater (annual)<sub>1...12</sub>

|         |
|---------|
| 2153.11 |
|---------|

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= 

|       |       |       |      |       |       |       |       |       |    |       |       |
|-------|-------|-------|------|-------|-------|-------|-------|-------|----|-------|-------|
| 66.92 | 58.89 | 61.63 | 54.7 | 52.86 | 46.38 | 44.16 | 49.49 | 50.05 | 57 | 60.64 | 65.21 |
|-------|-------|-------|------|-------|-------|-------|-------|-------|----|-------|-------|

(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    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 138.28 | 138.28 | 138.28 | 138.28 | 138.28 | 138.28 | 138.28 | 138.28 | 138.28 | 138.28 | 138.28 | 138.28 |

(66)

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

(67)m= 

|       |       |       |       |      |      |      |       |       |       |       |       |
|-------|-------|-------|-------|------|------|------|-------|-------|-------|-------|-------|
| 23.28 | 20.67 | 16.81 | 12.73 | 9.51 | 8.03 | 8.68 | 11.28 | 15.14 | 19.23 | 22.44 | 23.92 |
|-------|-------|-------|-------|------|------|------|-------|-------|-------|-------|-------|

(67)

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

(68)m= 

|        |       |        |        |        |        |        |        |        |        |        |        |
|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 261.09 | 263.8 | 256.97 | 242.44 | 224.09 | 206.84 | 195.32 | 192.62 | 199.44 | 213.98 | 232.32 | 249.57 |
|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(68)

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

(69)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 36.83 | 36.83 | 36.83 | 36.83 | 36.83 | 36.83 | 36.83 | 36.83 | 36.83 | 36.83 | 36.83 | 36.83 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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= 

|         |         |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 | -110.62 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

(71)

Water heating gains (Table 5)

(72)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 89.94 | 87.63 | 82.84 | 75.97 | 71.05 | 64.41 | 59.35 | 66.52 | 69.51 | 76.61 | 84.23 | 87.64 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(72)

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

(73)m= 

|        |        |        |        |        |        |        |       |        |       |        |        |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|-------|--------|--------|
| 441.79 | 439.59 | 424.11 | 398.62 | 372.14 | 346.78 | 330.84 | 337.9 | 351.58 | 377.3 | 406.48 | 428.62 |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|-------|--------|--------|

(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                      | 9.45                   | 19.64            | 0.63           | 0.7            | 56.72 (76)   |
| East         | 0.9x                      | 9.45                   | 38.42            | 0.63           | 0.7            | 110.96 (76)  |
| East         | 0.9x                      | 9.45                   | 63.27            | 0.63           | 0.7            | 182.74 (76)  |
| East         | 0.9x                      | 9.45                   | 92.28            | 0.63           | 0.7            | 266.51 (76)  |
| East         | 0.9x                      | 9.45                   | 113.09           | 0.63           | 0.7            | 326.62 (76)  |
| East         | 0.9x                      | 9.45                   | 115.77           | 0.63           | 0.7            | 334.35 (76)  |
| East         | 0.9x                      | 9.45                   | 110.22           | 0.63           | 0.7            | 318.32 (76)  |
| East         | 0.9x                      | 9.45                   | 94.68            | 0.63           | 0.7            | 273.43 (76)  |
| East         | 0.9x                      | 9.45                   | 73.59            | 0.63           | 0.7            | 212.53 (76)  |
| East         | 0.9x                      | 9.45                   | 45.59            | 0.63           | 0.7            | 131.66 (76)  |
| East         | 0.9x                      | 9.45                   | 24.49            | 0.63           | 0.7            | 70.73 (76)   |
| East         | 0.9x                      | 9.45                   | 16.15            | 0.63           | 0.7            | 46.65 (76)   |
| West         | 0.9x                      | 13.5                   | 19.64            | 0.63           | 0.7            | 81.03 (80)   |
| West         | 0.9x                      | 13.5                   | 38.42            | 0.63           | 0.7            | 158.51 (80)  |
| West         | 0.9x                      | 13.5                   | 63.27            | 0.63           | 0.7            | 261.05 (80)  |
| West         | 0.9x                      | 13.5                   | 92.28            | 0.63           | 0.7            | 380.73 (80)  |
| West         | 0.9x                      | 13.5                   | 113.09           | 0.63           | 0.7            | 466.6 (80)   |
| West         | 0.9x                      | 13.5                   | 115.77           | 0.63           | 0.7            | 477.64 (80)  |
| West         | 0.9x                      | 13.5                   | 110.22           | 0.63           | 0.7            | 454.74 (80)  |
| West         | 0.9x                      | 13.5                   | 94.68            | 0.63           | 0.7            | 390.61 (80)  |
| West         | 0.9x                      | 13.5                   | 73.59            | 0.63           | 0.7            | 303.61 (80)  |
| West         | 0.9x                      | 13.5                   | 45.59            | 0.63           | 0.7            | 188.09 (80)  |
| West         | 0.9x                      | 13.5                   | 24.49            | 0.63           | 0.7            | 101.04 (80)  |
| West         | 0.9x                      | 13.5                   | 16.15            | 0.63           | 0.7            | 66.64 (80)   |

Solar gains in watts, calculated for each month

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

(83)m= 137.75 269.47 443.79 647.24 793.21 811.99 773.05 664.04 516.14 319.75 171.76 113.28 (83)

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

(84)m= 579.54 709.06 867.9 1045.85 1165.35 1158.77 1103.89 1001.94 867.72 697.06 578.24 541.9 (84)

## 7. Mean internal temperature (heating season)

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

21 (85)

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

|        | Jan | Feb | Mar  | Apr  | May  | Jun  | Jul | Aug  | Sep  | Oct  | Nov | Dec |
|--------|-----|-----|------|------|------|------|-----|------|------|------|-----|-----|
| (86)m= | 1   | 1   | 0.99 | 0.94 | 0.83 | 0.66 | 0.5 | 0.56 | 0.83 | 0.98 | 1   | 1   |

(86)

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

(87)m= 19.57 19.76 20.08 20.49 20.8 20.95 20.99 20.98 20.86 20.41 19.91 19.54 (87)

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

(88)m= 19.87 19.87 19.87 19.88 19.88 19.89 19.89 19.9 19.89 19.88 19.88 19.88 (88)

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

|        | 1 | 0.99 | 0.98 | 0.92 | 0.78 | 0.56 | 0.38 | 0.44 | 0.75 | 0.97 | 1 | 1 |
|--------|---|------|------|------|------|------|------|------|------|------|---|---|
| (89)m= |   |      |      |      |      |      |      |      |      |      |   |   |

(89)

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

|        |       |       |       |      |      |       |       |       |       |      |       |       |      |
|--------|-------|-------|-------|------|------|-------|-------|-------|-------|------|-------|-------|------|
| (90)m= | 17.96 | 18.24 | 18.71 | 19.3 | 19.7 | 19.86 | 19.89 | 19.89 | 19.78 | 19.2 | 18.48 | 17.93 | (90) |
|--------|-------|-------|-------|------|------|-------|-------|-------|-------|------|-------|-------|------|

fLA = Living area ÷ (4) =

0.14 (91)

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

|        |       |       |      |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (92)m= | 18.18 | 18.45 | 18.9 | 19.46 | 19.85 | 20.01 | 20.04 | 20.04 | 19.93 | 19.37 | 18.67 | 18.15 | (92) |
|--------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |      |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (93)m= | 18.18 | 18.45 | 18.9 | 19.46 | 19.85 | 20.01 | 20.04 | 20.04 | 19.93 | 19.37 | 18.67 | 18.15 | (93) |
|--------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

## 8. Space heating requirement

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

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

Utilisation factor for gains, hm:

|        |   |      |      |      |      |      |      |      |      |      |      |   |      |
|--------|---|------|------|------|------|------|------|------|------|------|------|---|------|
| (94)m= | 1 | 0.99 | 0.97 | 0.91 | 0.78 | 0.57 | 0.39 | 0.45 | 0.76 | 0.96 | 0.99 | 1 | (94) |
|--------|---|------|------|------|------|------|------|------|------|------|------|---|------|

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

|        |        |        |        |        |        |        |        |        |        |        |       |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|------|
| (95)m= | 577.58 | 702.98 | 844.93 | 955.06 | 906.04 | 662.93 | 433.74 | 454.96 | 656.09 | 667.41 | 574.1 | 540.55 | (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= | 1813.74 | 1765.45 | 1611.69 | 1357.42 | 1045.34 | 687.51 | 436.98 | 461.22 | 742.8 | 1124.91 | 1490.8 | 1804.9 | (97) |
|--------|---------|---------|---------|---------|---------|--------|--------|--------|-------|---------|--------|--------|------|

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

|                                                               |       |        |        |       |        |   |   |   |   |        |        |         |      |
|---------------------------------------------------------------|-------|--------|--------|-------|--------|---|---|---|---|--------|--------|---------|------|
| (98)m=                                                        | 919.7 | 713.98 | 570.47 | 289.7 | 103.64 | 0 | 0 | 0 | 0 | 340.38 | 660.02 | 940.67  |      |
| Total per year (kWh/year) = Sum(98) <sub>1...5,9...12</sub> = |       |        |        |       |        |   |   |   |   |        |        | 4538.57 | (98) |

Space heating requirement in kWh/m²/year

44.06 (99)

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

### Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = 1 – (201) =

1 (202)

Fraction of total heating from main system 1

(204) = (202) × [1 – (203)] =

1 (204)

Efficiency of main space heating system 1

93.4 (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)

|       |        |        |       |        |   |   |   |   |        |        |        |
|-------|--------|--------|-------|--------|---|---|---|---|--------|--------|--------|
| 919.7 | 713.98 | 570.47 | 289.7 | 103.64 | 0 | 0 | 0 | 0 | 340.38 | 660.02 | 940.67 |
|-------|--------|--------|-------|--------|---|---|---|---|--------|--------|--------|

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

(211)

|        |        |        |        |        |   |   |   |   |        |        |         |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|---------|
| 984.69 | 764.44 | 610.78 | 310.17 | 110.97 | 0 | 0 | 0 | 0 | 364.43 | 706.66 | 1007.15 |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|---------|

Total (kWh/year) =Sum(211)<sub>1...5,10...12</sub> =

4859.29 (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...5,10...12</sub> = |   |   |   |   |   |   |   |   |   |   |   | 0 | (215) |

### Water heating

Output from water heater (calculated above)

|       |        |        |        |        |        |        |        |       |        |        |        |
|-------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|
| 213.9 | 188.53 | 198.01 | 176.48 | 170.86 | 150.48 | 144.18 | 160.72 | 162.5 | 184.08 | 194.62 | 208.75 |
|-------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|

Efficiency of water heater

80.3 (216)

## TER WorkSheet: New dwelling as built

(217)m= 

|      |       |       |       |       |      |      |      |      |       |       |       |
|------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|
| 88.3 | 88.09 | 87.56 | 86.29 | 83.84 | 80.3 | 80.3 | 80.3 | 80.3 | 86.58 | 87.88 | 88.38 |
|------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|

 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m= 

|        |        |        |        |       |       |        |        |        |        |        |       |
|--------|--------|--------|--------|-------|-------|--------|--------|--------|--------|--------|-------|
| 242.23 | 214.03 | 226.14 | 204.51 | 203.8 | 187.4 | 179.55 | 200.15 | 202.36 | 212.61 | 221.46 | 236.2 |
|--------|--------|--------|--------|-------|-------|--------|--------|--------|--------|--------|-------|

Total = Sum(219a)<sub>1...12</sub> =

|         |
|---------|
| 2530.44 |
|---------|

 (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

411.07

(232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

7875.8

(238)

### 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                         | = | 1049.61 (261)            |
| Space heating (secondary)                         | (215) x                         | 0.519                         | = | 0 (263)                  |
| Water heating                                     | (219) x                         | 0.216                         | = | 546.58 (264)             |
| Space and water heating                           | (261) + (262) + (263) + (264) = |                               |   | 1596.18 (265)            |
| Electricity for pumps, fans and electric keep-hot | (231) x                         | 0.519                         | = | 38.93 (267)              |
| Electricity for lighting                          | (232) x                         | 0.519                         | = | 213.35 (268)             |
| Total CO2, kg/year                                |                                 | sum of (265)...(271) =        |   | 1848.45 (272)            |

**TER =**

|       |
|-------|
| 17.95 |
|-------|

 (273)