

# 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: 156.4m<sup>2</sup>

**Site Reference :** Stoneham Park

**Plot Reference:** Plot 459

**Address :** 37 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) 15.34 kg/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 12.09 kg/m<sup>2</sup>

OK

## 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 55.0 kWh/m<sup>2</sup>

Dwelling Fabric Energy Efficiency (DFEE) 46.1 kWh/m<sup>2</sup>

OK

## 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.24 (max. 0.30) | 0.24 (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      | 1.35 (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 | 4.27 |    |
| Maximum                        | 10.0 | OK |

## 4 Heating efficiency

|                           |                                                                                                                                                                                                                                                |    |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Main Heating system:      | Database: (rev 508, product index 018042):<br>Boiler systems with radiators or underfloor heating - mains gas<br>Brand name: Ideal<br>Model: LOGIC HEAT<br>Model qualifier: H18<br>(Regular)<br>Efficiency 89.6 % SEDBUK2009<br>Minimum 88.0 % | OK |
| Secondary heating system: | None                                                                                                                                                                                                                                           |    |

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## 5 Cylinder insulation

|                             |                                      |    |
|-----------------------------|--------------------------------------|----|
| Hot water Storage:          | Measured cylinder loss: 1.49 kWh/day |    |
|                             | Permitted by DBSCG: 2.30 kWh/day     | OK |
| Primary pipework insulated: | Yes                                  | OK |

## 6 Controls

|                        |                                          |    |
|------------------------|------------------------------------------|----|
| Space heating controls | TTZC by plumbing and electrical services | OK |
| Hot water controls:    | Cylinderstat                             | OK |
|                        | Independent timer for DHW                | OK |
| 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              | 10.55m <sup>2</sup> |    |
| Windows facing: West              | 16.85m <sup>2</sup> |    |
| Ventilation rate:                 | 4.00                |    |
| Blinds/curtains:                  | None                |    |

## 10 Key features

|                    |                          |
|--------------------|--------------------------|
| Thermal bridging   | 0.031 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 459

**Address :** 37 Hopper Road, EASTLEIGH, SO50 9SH

## 1. Overall dwelling dimensions:

|                                                           | Area(m <sup>2</sup> ) | Av. Height(m)                        | Volume(m <sup>3</sup> ) |
|-----------------------------------------------------------|-----------------------|--------------------------------------|-------------------------|
| Ground floor                                              | 78.2 (1a) x           | 2.46 (2a) =                          | 192.37 (3a)             |
| First floor                                               | 78.2 (1b) x           | 2.54 (2b) =                          | 198.63 (3b)             |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 156.4 (4)             |                                      |                         |
| Dwelling volume                                           |                       | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 391 (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                                                      |                                          | 4.26999998092651 (17) |
| If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)                                                               |                                          | 0.21 (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) =                     | 0.18 (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

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

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 Type 1               |                 |             | 2.1            | x 1                  | = 2.1       |                 | (26)         |
| Doors Type 2               |                 |             | 2              | x 1                  | = 2         |                 | (26)         |
| Windows Type 1             |                 |             | 10.55          | x1/[1/( 1.4 )+ 0.04] | = 13.99     |                 | (27)         |
| Windows Type 2             |                 |             | 16.85          | x1/[1/( 1.4 )+ 0.04] | = 22.34     |                 | (27)         |
| Floor                      |                 |             | 78.2           | x 0.12               | = 9.384     | 75              | 5865 (28)    |
| Walls                      | 185.5           | 31.5        | 154            | x 0.24               | = 36.96     | 52              | 8008 (29)    |
| Roof                       | 78.2            | 0           | 78.2           | x 0.11               | = 8.6       | 9               | 703.8 (30)   |
| Total area of elements, m² |                 |             | 341.9          |                      |             |                 | (31)         |
| Internal wall **           |                 |             | 220.8          |                      |             | 9               | 1987.2 (32c) |
| Internal wall **           |                 |             | 43             |                      |             | 75              | 3225 (32c)   |
| Internal floor             |                 |             | 78.2           |                      |             | 18              | 1407.6 (32d) |
| Internal ceiling           |                 |             | 78.2           |                      |             | 9               | 703.8 (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) = 95.37 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 21900.4 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 140.03 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

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

10.53 (36)

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

Total fabric heat loss

(33) + (36) =

105.9 (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= | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 |

(38)

Heat transfer coefficient, W/K

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

|        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| (39)m= | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

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

170.42 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

|        |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| (40)m= | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|

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

1.09 (40)

Number of days in month (Table 1a)

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

(41)

## 4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.94

(42)

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

if TFA ≤ 13.9, N = 1

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

104.11

(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= | 114.53 | 110.36 | 106.2 | 102.03 | 97.87 | 93.7 | 93.7 | 97.87 | 102.03 | 106.2 | 110.36 | 114.53 |
|--------|--------|--------|-------|--------|-------|------|------|-------|--------|-------|--------|--------|

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

1249.38 (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= | 169.84 | 148.54 | 153.28 | 133.64 | 128.23 | 110.65 | 102.53 | 117.66 | 119.06 | 138.76 | 151.46 | 164.48 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

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

1638.13 (45)

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

|        |       |       |       |       |       |      |       |       |       |       |       |       |
|--------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| (46)m= | 25.48 | 22.28 | 22.99 | 20.05 | 19.23 | 16.6 | 15.38 | 17.65 | 17.86 | 20.81 | 22.72 | 24.67 |
|--------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|

(46)

Water storage loss:

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

210

(47)

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

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

Water storage loss:

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

1.49

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0.8

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

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

|     |
|-----|
| 0   |
| 0.8 |

 (54)

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

|     |
|-----|
| 0.8 |
|-----|

 (55)

Water storage loss calculated for each month  $((56)m = (55) \times (41)m$

(56)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 24.94 | 22.53 | 24.94 | 24.14 | 24.94 | 24.14 | 24.94 | 24.94 | 24.14 | 24.94 | 24.14 | 24.94 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

 (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= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 24.94 | 22.53 | 24.94 | 24.14 | 24.94 | 24.14 | 24.94 | 24.94 | 24.14 | 24.94 | 24.14 | 24.94 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

 (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= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

 (59)

Combi loss calculated for each month  $(61)m = (60) \div 365 \times (41)m$

(61)m= 

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

 (61)

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

(62)m= 

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 218.04 | 192.08 | 201.49 | 180.29 | 176.43 | 157.3 | 150.74 | 165.86 | 165.71 | 186.96 | 198.11 | 212.69 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

 (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= 

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 218.04 | 192.08 | 201.49 | 180.29 | 176.43 | 157.3 | 150.74 | 165.86 | 165.71 | 186.96 | 198.11 | 212.69 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

|                                                     |         |
|-----------------------------------------------------|---------|
| Output from water heater (annual) <sub>1...12</sub> | 2205.71 |
|-----------------------------------------------------|---------|

 (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= 

|       |       |       |       |      |       |       |       |       |      |       |       |
|-------|-------|-------|-------|------|-------|-------|-------|-------|------|-------|-------|
| 95.04 | 84.22 | 89.53 | 81.75 | 81.2 | 74.11 | 72.66 | 77.69 | 76.91 | 84.7 | 87.68 | 93.25 |
|-------|-------|-------|-------|------|-------|-------|-------|-------|------|-------|-------|

 (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    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 176.63 | 176.63 | 176.63 | 176.63 | 176.63 | 176.63 | 176.63 | 176.63 | 176.63 | 176.63 | 176.63 | 176.63 |

 (66)

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

(67)m= 

|       |       |       |       |      |       |       |       |      |       |       |       |
|-------|-------|-------|-------|------|-------|-------|-------|------|-------|-------|-------|
| 74.86 | 66.49 | 54.08 | 40.94 | 30.6 | 25.84 | 27.92 | 36.29 | 48.7 | 61.84 | 72.18 | 76.94 |
|-------|-------|-------|-------|------|-------|-------|-------|------|-------|-------|-------|

 (67)

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

(68)m= 

|        |        |        |        |        |        |        |       |        |        |        |       |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|-------|
| 488.66 | 493.73 | 480.95 | 453.75 | 419.41 | 387.14 | 365.57 | 360.5 | 373.28 | 400.48 | 434.82 | 467.1 |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|-------|

 (68)

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

(69)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 55.61 | 55.61 | 55.61 | 55.61 | 55.61 | 55.61 | 55.61 | 55.61 | 55.61 | 55.61 | 55.61 | 55.61 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

 (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= 

|         |         |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

 (71)

Water heating gains (Table 5)

(72)m= 

|        |        |        |        |        |        |       |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|
| 127.74 | 125.33 | 120.34 | 113.55 | 109.14 | 102.93 | 97.66 | 104.42 | 106.82 | 113.84 | 121.78 | 125.34 |
|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|

 (72)

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

(73)m= 

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 808.74 | 803.03 | 772.85 | 725.72 | 676.63 | 633.38 | 608.63 | 618.69 | 646.28 | 693.65 | 746.26 | 786.86 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

 (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                      | 10.55                  | 19.64            | 0.45           | 1.11           | 71.8 (76)    |
| East         | 0.9x                      | 10.55                  | 38.42            | 0.45           | 1.11           | 140.45 (76)  |
| East         | 0.9x                      | 10.55                  | 63.27            | 0.45           | 1.11           | 231.3 (76)   |
| East         | 0.9x                      | 10.55                  | 92.28            | 0.45           | 1.11           | 337.34 (76)  |
| East         | 0.9x                      | 10.55                  | 113.09           | 0.45           | 1.11           | 413.42 (76)  |
| East         | 0.9x                      | 10.55                  | 115.77           | 0.45           | 1.11           | 423.21 (76)  |
| East         | 0.9x                      | 10.55                  | 110.22           | 0.45           | 1.11           | 402.91 (76)  |
| East         | 0.9x                      | 10.55                  | 94.68            | 0.45           | 1.11           | 346.09 (76)  |
| East         | 0.9x                      | 10.55                  | 73.59            | 0.45           | 1.11           | 269.01 (76)  |
| East         | 0.9x                      | 10.55                  | 45.59            | 0.45           | 1.11           | 166.65 (76)  |
| East         | 0.9x                      | 10.55                  | 24.49            | 0.45           | 1.11           | 89.52 (76)   |
| East         | 0.9x                      | 10.55                  | 16.15            | 0.45           | 1.11           | 59.04 (76)   |
| West         | 0.9x                      | 16.85                  | 19.64            | 0.45           | 1.11           | 114.67 (80)  |
| West         | 0.9x                      | 16.85                  | 38.42            | 0.45           | 1.11           | 224.32 (80)  |
| West         | 0.9x                      | 16.85                  | 63.27            | 0.45           | 1.11           | 369.42 (80)  |
| West         | 0.9x                      | 16.85                  | 92.28            | 0.45           | 1.11           | 538.78 (80)  |
| West         | 0.9x                      | 16.85                  | 113.09           | 0.45           | 1.11           | 660.29 (80)  |
| West         | 0.9x                      | 16.85                  | 115.77           | 0.45           | 1.11           | 675.93 (80)  |
| West         | 0.9x                      | 16.85                  | 110.22           | 0.45           | 1.11           | 643.51 (80)  |
| West         | 0.9x                      | 16.85                  | 94.68            | 0.45           | 1.11           | 552.77 (80)  |
| West         | 0.9x                      | 16.85                  | 73.59            | 0.45           | 1.11           | 429.65 (80)  |
| West         | 0.9x                      | 16.85                  | 45.59            | 0.45           | 1.11           | 266.17 (80)  |
| West         | 0.9x                      | 16.85                  | 24.49            | 0.45           | 1.11           | 142.98 (80)  |
| West         | 0.9x                      | 16.85                  | 16.15            | 0.45           | 1.11           | 94.3 (80)    |

Solar gains in watts, calculated for each month

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

(83)m= 186.47 364.77 600.72 876.12 1073.71 1099.14 1046.42 898.86 698.66 432.83 232.5 153.34 (83)

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

(84)m= 995.21 1167.8 1373.57 1601.83 1750.35 1732.52 1655.05 1517.55 1344.95 1126.48 978.76 940.2 (84)

## 7. Mean internal temperature (heating season)

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

21

(85)

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

|        | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| (86)m= | 0.98 | 0.97 | 0.93 | 0.86 | 0.73 | 0.57 | 0.44 | 0.49 | 0.72 | 0.91 | 0.97 | 0.98 |

(86)

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

(87)m= 19.25 19.49 19.89 20.36 20.72 20.91 20.97 20.96 20.8 20.3 19.67 19.19 (87)

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

(88)m= 20.01 20.01 20.01 20.01 20.01 20.01 20.01 20.01 20.01 20.01 20.01 20.01 (88)

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

(89)m= 0.98 0.96 0.92 0.83 0.68 0.5 0.34 0.39 0.65 0.89 0.96 0.98 (89)

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (90)m= | 17.67 | 18.02 | 18.59 | 19.24 | 19.71 | 19.93 | 19.99 | 19.99 | 19.83 | 19.18 | 18.28 | 17.58 | (90) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

0.09 (91)

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

|        |       |       |       |       |      |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|------|
| (92)m= | 17.82 | 18.15 | 18.71 | 19.34 | 19.8 | 20.02 | 20.08 | 20.07 | 19.92 | 19.28 | 18.41 | 17.73 | (92) |
|--------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |    |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (93)m= | 17.67 | 18 | 18.56 | 19.19 | 19.65 | 19.87 | 19.93 | 19.92 | 19.77 | 19.13 | 18.26 | 17.58 | (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,  $hm$ :

|        |      |      |     |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|-----|------|------|------|------|------|------|------|------|------|------|
| (94)m= | 0.96 | 0.94 | 0.9 | 0.81 | 0.66 | 0.49 | 0.34 | 0.39 | 0.63 | 0.86 | 0.95 | 0.97 | (94) |
|--------|------|------|-----|------|------|------|------|------|------|------|------|------|------|

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

|        |        |         |         |      |         |        |        |       |        |        |        |        |      |
|--------|--------|---------|---------|------|---------|--------|--------|-------|--------|--------|--------|--------|------|
| (95)m= | 960.15 | 1101.62 | 1232.67 | 1290 | 1163.96 | 848.84 | 557.96 | 584.5 | 849.62 | 967.29 | 925.57 | 911.93 | (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= | 2277.82 | 2232.74 | 2054.63 | 1753.85 | 1355.1 | 898.71 | 568.11 | 600.6 | 965.72 | 1453.75 | 1902.11 | 2279.58 | (97) |
|--------|---------|---------|---------|---------|--------|--------|--------|-------|--------|---------|---------|---------|------|

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

|        |        |        |        |        |        |   |   |   |   |        |        |         |      |
|--------|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|---------|------|
| (98)m= | 980.35 | 760.11 | 611.54 | 333.97 | 142.21 | 0 | 0 | 0 | 0 | 361.92 | 703.11 | 1017.53 | (98) |
|--------|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|---------|------|

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

4910.74 (98)

Space heating requirement in  $kWh/m^2/year$

31.4 (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

90.6 (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)

|        |        |        |        |        |   |   |   |   |        |        |         |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|---------|
| 980.35 | 760.11 | 611.54 | 333.97 | 142.21 | 0 | 0 | 0 | 0 | 361.92 | 703.11 | 1017.53 |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|---------|

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

|         |        |        |        |        |   |   |   |   |        |        |        |
|---------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|
| 1082.06 | 838.98 | 674.98 | 368.62 | 156.97 | 0 | 0 | 0 | 0 | 399.47 | 776.06 | 1123.1 |
|---------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|

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

5420.24 (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 | (215) |
|---------|---|---|---|---|---|---|---|---|---|---|---|-------|

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} =$$

0 (215)

### Water heating

Output from water heater (calculated above)

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 218.04 | 192.08 | 201.49 | 180.29 | 176.43 | 157.3 | 150.74 | 165.86 | 165.71 | 186.96 | 198.11 | 212.69 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

Efficiency of water heater

79.9 (216)

# SAP WorkSheet: New dwelling as built

|         |       |       |       |       |       |      |      |      |      |       |       |       |       |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|
| (217)m= | 88.44 | 88.22 | 87.69 | 86.54 | 84.35 | 79.9 | 79.9 | 79.9 | 79.9 | 86.65 | 88.01 | 88.55 | (217) |
|---------|-------|-------|-------|-------|-------|------|------|------|------|-------|-------|-------|-------|

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

|                                       |        |        |        |        |        |        |        |        |       |        |        |         |       |
|---------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|---------|-------|
| (219)m=                               | 246.53 | 217.74 | 229.77 | 208.33 | 209.18 | 196.87 | 188.66 | 207.59 | 207.4 | 215.77 | 225.11 | 240.19  |       |
| Total = Sum(219a) <sub>1...12</sub> = |        |        |        |        |        |        |        |        |       |        |        | 2593.14 | (219) |

## Annual totals

Space heating fuel used, main system 1

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

central heating pump:

boiler with a fan-assisted flue

Total electricity for the above, kWh/year

Electricity for lighting

Electricity generated by PVs

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

kWh/year

kWh/year

105.77

30

45

sum of (230a)...(230g) =

180.77 (231)

528.84 (232)

-747.25 (233)

7975.73 (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 = 188.62 (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 = 90.24 (247)  |
| Pumps, fans and electric keep-hot                                                                                       | (231)                   | 13.19                    | x 0.01 = 23.84 (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 = 69.75 (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

**Total energy cost** (245)...(247) + (250)...(254) = 393.9 (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] = | 0.82 (257)  |
| <b>SAP rating (Section 12)</b>                            | 88.54 (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 |
|--------------------|-------------------------------|--------------------------|
|--------------------|-------------------------------|--------------------------|

## SAP WorkSheet: New dwelling as built

|                                                   |                                 |                        |   |         |       |
|---------------------------------------------------|---------------------------------|------------------------|---|---------|-------|
| Space heating (main system 1)                     | (211) x                         | 0.216                  | = | 1170.77 | (261) |
| Space heating (secondary)                         | (215) x                         | 0.519                  | = | 0       | (263) |
| Water heating                                     | (219) x                         | 0.216                  | = | 560.12  | (264) |
| Space and water heating                           | (261) + (262) + (263) + (264) = |                        |   | 1730.89 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x                         | 0.519                  | = | 93.82   | (267) |
| Electricity for lighting                          | (232) x                         | 0.519                  | = | 274.47  | (268) |
| Energy saving/generation technologies<br>Item 1   |                                 | 0.519                  | = | -387.82 | (269) |
| Total CO <sub>2</sub> , kg/year                   |                                 | sum of (265)...(271) = |   | 1711.35 | (272) |
| <b>CO<sub>2</sub> emissions per m<sup>2</sup></b> |                                 | (272) ÷ (4) =          |   | 10.94   | (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                   | = | 6612.69               | (261) |
| Space heating (secondary)                         | (215) x                         | 3.07                   | = | 0                     | (263) |
| Energy for water heating                          | (219) x                         | 1.22                   | = | 3163.63               | (264) |
| Space and water heating                           | (261) + (262) + (263) + (264) = |                        |   | 9776.32               | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x                         | 3.07                   | = | 554.97                | (267) |
| Electricity for lighting                          | (232) x                         | 0                      | = | 1623.53               | (268) |
| Energy saving/generation technologies<br>Item 1   |                                 | 3.07                   | = | -2294.07              | (269) |
| 'Total Primary Energy                             |                                 | sum of (265)...(271) = |   | 9660.75               | (272) |
| <b>Primary energy kWh/m<sup>2</sup>/year</b>      |                                 | (272) ÷ (4) =          |   | 61.77                 | (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 459

**Address :** 37 Hopper Road, EASTLEIGH, SO50 9SH

## 1. Overall dwelling dimensions:

|                                                           | Area(m <sup>2</sup> ) | Av. Height(m)                        | Volume(m <sup>3</sup> ) |
|-----------------------------------------------------------|-----------------------|--------------------------------------|-------------------------|
| Ground floor                                              | 78.2 (1a) x           | 2.46 (2a) =                          | 192.37 (3a)             |
| First floor                                               | 78.2 (1b) x           | 2.54 (2b) =                          | 198.63 (3b)             |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 156.4 (4)             |                                      |                         |
| Dwelling volume                                           |                       | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 391 (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                                                      |                                          |               | 4.26999998092651 (17) |
| If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)                                                               |                                          |               | 0.21 (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) =                     |               | 0.18 (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

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

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 0 (24a)

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

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

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

if (22b)m < 0.5 × (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 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 Type 1               |                 |             | 2.1            | x 1                   | = 2.1       |                 | (26)         |
| Doors Type 2               |                 |             | 2              | x 1                   | = 2         |                 | (26)         |
| Windows Type 1             |                 |             | 10.55          | x 1/[1/( 1.4 )+ 0.04] | = 13.99     |                 | (27)         |
| Windows Type 2             |                 |             | 16.85          | x 1/[1/( 1.4 )+ 0.04] | = 22.34     |                 | (27)         |
| Floor                      |                 |             | 78.2           | x 0.12                | = 9.384     | 75              | 5865 (28)    |
| Walls                      | 185.5           | 31.5        | 154            | x 0.24                | = 36.96     | 52              | 8008 (29)    |
| Roof                       | 78.2            | 0           | 78.2           | x 0.11                | = 8.6       | 9               | 703.8 (30)   |
| Total area of elements, m² |                 |             | 341.9          |                       |             |                 | (31)         |
| Internal wall **           |                 |             | 220.8          |                       |             | 9               | 1987.2 (32c) |
| Internal wall **           |                 |             | 43             |                       |             | 75              | 3225 (32c)   |
| Internal floor             |                 |             | 78.2           |                       |             | 18              | 1407.6 (32d) |
| Internal ceiling           |                 |             | 78.2           |                       |             | 9               | 703.8 (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) = 95.37 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 21900.4 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 140.03 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

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

10.53 (36)

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

Total fabric heat loss

(33) + (36) =

105.9 (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= | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 | 64.51 |

(38)

Heat transfer coefficient, W/K

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

|        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| (39)m= | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 | 170.42 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

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

170.42 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

|        |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| (40)m= | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|

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

1.09 (40)

Number of days in month (Table 1a)

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

(41)

## 4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.94

(42)

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

if TFA ≤ 13.9, N = 1

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

104.11

(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= | 114.53 | 110.36 | 106.2 | 102.03 | 97.87 | 93.7 | 93.7 | 97.87 | 102.03 | 106.2 | 110.36 | 114.53 |
|--------|--------|--------|-------|--------|-------|------|------|-------|--------|-------|--------|--------|

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

1249.38 (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= | 169.84 | 148.54 | 153.28 | 133.64 | 128.23 | 110.65 | 102.53 | 117.66 | 119.06 | 138.76 | 151.46 | 164.48 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

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

1638.13 (45)

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

|        |       |       |       |       |       |      |       |       |       |       |       |       |
|--------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| (46)m= | 25.48 | 22.28 | 22.99 | 20.05 | 19.23 | 16.6 | 15.38 | 17.65 | 17.86 | 20.81 | 22.72 | 24.67 |
|--------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|

(46)

Water storage loss:

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

210

(47)

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

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

Water storage loss:

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

1.49

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0.8

(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) x (51) x (52) x (53) =

|     |
|-----|
| 0   |
| 0.8 |

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

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

(56)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 24.94 | 22.53 | 24.94 | 24.14 | 24.94 | 24.14 | 24.94 | 24.94 | 24.14 | 24.94 | 24.14 | 24.94 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(56)

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

(57)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 24.94 | 22.53 | 24.94 | 24.14 | 24.94 | 24.14 | 24.94 | 24.94 | 24.14 | 24.94 | 24.14 | 24.94 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(57)

Primary circuit loss (annual) from Table 3 

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

(58)

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

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

(59)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(59)

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

(61)m= 

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

(61)

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

(62)m= 

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 218.04 | 192.08 | 201.49 | 180.29 | 176.43 | 157.3 | 150.74 | 165.86 | 165.71 | 186.96 | 198.11 | 212.69 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

(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= 

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 218.04 | 192.08 | 201.49 | 180.29 | 176.43 | 157.3 | 150.74 | 165.86 | 165.71 | 186.96 | 198.11 | 212.69 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

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

|         |
|---------|
| 2205.71 |
|---------|

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= 

|       |       |       |       |      |       |       |       |       |      |       |       |
|-------|-------|-------|-------|------|-------|-------|-------|-------|------|-------|-------|
| 95.04 | 84.22 | 89.53 | 81.75 | 81.2 | 74.11 | 72.66 | 77.69 | 76.91 | 84.7 | 87.68 | 93.25 |
|-------|-------|-------|-------|------|-------|-------|-------|-------|------|-------|-------|

(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    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 147.19 | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 |

(66)

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

(67)m= 

|       |      |       |       |       |       |       |       |       |       |       |       |
|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 29.94 | 26.6 | 21.63 | 16.38 | 12.24 | 10.33 | 11.17 | 14.51 | 19.48 | 24.74 | 28.87 | 30.78 |
|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(67)

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

(68)m= 

|       |       |        |        |     |        |        |        |       |        |        |        |
|-------|-------|--------|--------|-----|--------|--------|--------|-------|--------|--------|--------|
| 327.4 | 330.8 | 322.24 | 304.01 | 281 | 259.38 | 244.93 | 241.54 | 250.1 | 268.32 | 291.33 | 312.96 |
|-------|-------|--------|--------|-----|--------|--------|--------|-------|--------|--------|--------|

(68)

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

(69)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 37.72 | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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= 

|         |         |         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

(71)

Water heating gains (Table 5)

(72)m= 

|        |        |        |        |        |        |       |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|
| 127.74 | 125.33 | 120.34 | 113.55 | 109.14 | 102.93 | 97.66 | 104.42 | 106.82 | 113.84 | 121.78 | 125.34 |
|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|

(72)

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

(73)m= 

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 555.24 | 552.88 | 534.36 | 504.09 | 472.54 | 442.8 | 423.91 | 430.62 | 446.55 | 477.06 | 512.14 | 539.23 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

(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                      | 10.55                  | 19.64            | 0.45           | 1.11           | 71.8 (76)    |
| East         | 0.9x                      | 10.55                  | 38.42            | 0.45           | 1.11           | 140.45 (76)  |
| East         | 0.9x                      | 10.55                  | 63.27            | 0.45           | 1.11           | 231.3 (76)   |
| East         | 0.9x                      | 10.55                  | 92.28            | 0.45           | 1.11           | 337.34 (76)  |
| East         | 0.9x                      | 10.55                  | 113.09           | 0.45           | 1.11           | 413.42 (76)  |
| East         | 0.9x                      | 10.55                  | 115.77           | 0.45           | 1.11           | 423.21 (76)  |
| East         | 0.9x                      | 10.55                  | 110.22           | 0.45           | 1.11           | 402.91 (76)  |
| East         | 0.9x                      | 10.55                  | 94.68            | 0.45           | 1.11           | 346.09 (76)  |
| East         | 0.9x                      | 10.55                  | 73.59            | 0.45           | 1.11           | 269.01 (76)  |
| East         | 0.9x                      | 10.55                  | 45.59            | 0.45           | 1.11           | 166.65 (76)  |
| East         | 0.9x                      | 10.55                  | 24.49            | 0.45           | 1.11           | 89.52 (76)   |
| East         | 0.9x                      | 10.55                  | 16.15            | 0.45           | 1.11           | 59.04 (76)   |
| West         | 0.9x                      | 16.85                  | 19.64            | 0.45           | 1.11           | 114.67 (80)  |
| West         | 0.9x                      | 16.85                  | 38.42            | 0.45           | 1.11           | 224.32 (80)  |
| West         | 0.9x                      | 16.85                  | 63.27            | 0.45           | 1.11           | 369.42 (80)  |
| West         | 0.9x                      | 16.85                  | 92.28            | 0.45           | 1.11           | 538.78 (80)  |
| West         | 0.9x                      | 16.85                  | 113.09           | 0.45           | 1.11           | 660.29 (80)  |
| West         | 0.9x                      | 16.85                  | 115.77           | 0.45           | 1.11           | 675.93 (80)  |
| West         | 0.9x                      | 16.85                  | 110.22           | 0.45           | 1.11           | 643.51 (80)  |
| West         | 0.9x                      | 16.85                  | 94.68            | 0.45           | 1.11           | 552.77 (80)  |
| West         | 0.9x                      | 16.85                  | 73.59            | 0.45           | 1.11           | 429.65 (80)  |
| West         | 0.9x                      | 16.85                  | 45.59            | 0.45           | 1.11           | 266.17 (80)  |
| West         | 0.9x                      | 16.85                  | 24.49            | 0.45           | 1.11           | 142.98 (80)  |
| West         | 0.9x                      | 16.85                  | 16.15            | 0.45           | 1.11           | 94.3 (80)    |

Solar gains in watts, calculated for each month

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

|        |        |        |        |        |         |         |         |        |        |        |       |        |      |
|--------|--------|--------|--------|--------|---------|---------|---------|--------|--------|--------|-------|--------|------|
| (83)m= | 186.47 | 364.77 | 600.72 | 876.12 | 1073.71 | 1099.14 | 1046.42 | 898.86 | 698.66 | 432.83 | 232.5 | 153.34 | (83) |
|--------|--------|--------|--------|--------|---------|---------|---------|--------|--------|--------|-------|--------|------|

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

|        |        |        |         |         |         |         |         |         |         |        |        |        |      |
|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|--------|--------|--------|------|
| (84)m= | 741.71 | 917.65 | 1135.08 | 1380.21 | 1546.25 | 1541.94 | 1470.34 | 1329.49 | 1145.22 | 909.89 | 744.64 | 692.57 | (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)

|        |      |      |      |     |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|-----|------|------|------|------|------|------|------|------|------|
| (86)m= | Jan  | Feb  | Mar  | Apr | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  | (86) |
|        | 0.99 | 0.98 | 0.96 | 0.9 | 0.78 | 0.63 | 0.48 | 0.54 | 0.78 | 0.95 | 0.99 | 0.99 |      |

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (87)m= | 19.02 | 19.28 | 19.71 | 20.23 | 20.65 | 20.88 | 20.96 | 20.94 | 20.74 | 20.15 | 19.47 | 18.96 | (87) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (88)m= | 20.01 | 20.01 | 20.01 | 20.01 | 20.01 | 20.01 | 20.01 | 20.01 | 20.01 | 20.01 | 20.01 | 20.01 | (88) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |      |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| (89)m= | 0.99 | 0.98 | 0.95 | 0.88 | 0.74 | 0.55 | 0.38 | 0.44 | 0.72 | 0.93 | 0.98 | 0.99 | (89) |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|

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

|        |       |       |       |       |       |       |       |       |       |       |    |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|-------|------|
| (90)m= | 17.35 | 17.71 | 18.33 | 19.07 | 19.63 | 19.91 | 19.99 | 19.97 | 19.76 | 18.97 | 18 | 17.26 | (90) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|-------|------|

|                           |      |      |
|---------------------------|------|------|
| fLA = Living area ÷ (4) = | 0.09 | (91) |
|---------------------------|------|------|

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

|        |      |       |       |       |       |    |       |       |       |       |       |       |      |
|--------|------|-------|-------|-------|-------|----|-------|-------|-------|-------|-------|-------|------|
| (92)m= | 17.5 | 17.85 | 18.46 | 19.18 | 19.72 | 20 | 20.08 | 20.06 | 19.85 | 19.08 | 18.13 | 17.41 | (92) |
|--------|------|-------|-------|-------|-------|----|-------|-------|-------|-------|-------|-------|------|

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

|        |       |      |       |       |       |       |       |       |      |       |       |       |      |
|--------|-------|------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|------|
| (93)m= | 17.35 | 17.7 | 18.31 | 19.03 | 19.57 | 19.85 | 19.93 | 19.91 | 19.7 | 18.93 | 17.98 | 17.26 | (93) |
|--------|-------|------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|------|

### 8. Space heating requirement

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

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

Utilisation factor for gains, hm:

|        |      |      |      |      |      |      |      |      |     |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|-----|------|------|------|------|
| (94)m= | 0.98 | 0.97 | 0.93 | 0.85 | 0.71 | 0.54 | 0.38 | 0.43 | 0.7 | 0.91 | 0.97 | 0.99 | (94) |
|--------|------|------|------|------|------|------|------|------|-----|------|------|------|------|

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

|        |        |        |        |         |         |        |        |        |        |        |        |       |      |
|--------|--------|--------|--------|---------|---------|--------|--------|--------|--------|--------|--------|-------|------|
| (95)m= | 729.52 | 888.54 | 1057.3 | 1172.12 | 1104.26 | 828.76 | 552.88 | 575.83 | 798.02 | 825.13 | 723.85 | 683.3 | (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= | 2223.73 | 2182.09 | 2012.36 | 1725.72 | 1341.6 | 894.41 | 567.01 | 598.72 | 954.03 | 1419.35 | 1854.24 | 2226.16 | (97) |
|--------|---------|---------|---------|---------|--------|--------|--------|--------|--------|---------|---------|---------|------|

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

|                                                               |         |        |        |        |        |   |   |   |   |       |        |         |         |      |
|---------------------------------------------------------------|---------|--------|--------|--------|--------|---|---|---|---|-------|--------|---------|---------|------|
| (98)m=                                                        | 1111.69 | 869.27 | 710.56 | 398.59 | 176.58 | 0 | 0 | 0 | 0 | 442.1 | 813.88 | 1147.89 |         |      |
| Total per year (kWh/year) = Sum(98) <sub>1...5,9...12</sub> = |         |        |        |        |        |   |   |   |   |       |        |         | 5670.56 | (98) |

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

|       |      |
|-------|------|
| 36.26 | (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 90.6 (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)

|         |        |        |        |        |   |   |   |   |       |        |         |
|---------|--------|--------|--------|--------|---|---|---|---|-------|--------|---------|
| 1111.69 | 869.27 | 710.56 | 398.59 | 176.58 | 0 | 0 | 0 | 0 | 442.1 | 813.88 | 1147.89 |
|---------|--------|--------|--------|--------|---|---|---|---|-------|--------|---------|

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

|         |        |        |        |       |   |   |   |   |        |        |         |
|---------|--------|--------|--------|-------|---|---|---|---|--------|--------|---------|
| 1227.03 | 959.46 | 784.29 | 439.94 | 194.9 | 0 | 0 | 0 | 0 | 487.97 | 898.32 | 1266.98 |
|---------|--------|--------|--------|-------|---|---|---|---|--------|--------|---------|

Total (kWh/year) =Sum(211)<sub>1...5,10...12</sub>= 6258.9 (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)

|        |        |        |        |        |       |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|
| 218.04 | 192.08 | 201.49 | 180.29 | 176.43 | 157.3 | 150.74 | 165.86 | 165.71 | 186.96 | 198.11 | 212.69 |
|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|

Efficiency of water heater 79.9 (216)

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|         |       |       |    |       |       |      |      |      |      |       |       |       |       |
|---------|-------|-------|----|-------|-------|------|------|------|------|-------|-------|-------|-------|
| (217)m= | 88.65 | 88.46 | 88 | 86.97 | 84.92 | 79.9 | 79.9 | 79.9 | 79.9 | 87.13 | 88.29 | 88.74 | (217) |
|---------|-------|-------|----|-------|-------|------|------|------|------|-------|-------|-------|-------|

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

|                                      |        |        |        |        |        |        |        |        |       |        |       |         |       |
|--------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|-------|---------|-------|
| (219)m=                              | 245.95 | 217.15 | 228.97 | 207.29 | 207.77 | 196.87 | 188.66 | 207.59 | 207.4 | 214.57 | 224.4 | 239.67  |       |
| Total = Sum(219a) <sub>1..12</sub> = |        |        |        |        |        |        |        |        |       |        |       | 2586.29 | (219) |

### Annual totals

|                                        |          |  |  |  |  |  |  |  |  |  |          |  |
|----------------------------------------|----------|--|--|--|--|--|--|--|--|--|----------|--|
|                                        | kWh/year |  |  |  |  |  |  |  |  |  | kWh/year |  |
| Space heating fuel used, main system 1 |          |  |  |  |  |  |  |  |  |  | 6258.9   |  |
| Water heating fuel used                |          |  |  |  |  |  |  |  |  |  | 2586.29  |  |

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 105.77 (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) = 180.77 (231)

Electricity for lighting 528.84 (232)

Electricity generated by PVs -747.25 (233)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 8807.55 (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                         | =                      | 1351.92                  | (261) |
| Space heating (secondary)                         | (215) x                         | 0.519                         | =                      | 0                        | (263) |
| Water heating                                     | (219) x                         | 0.216                         | =                      | 558.64                   | (264) |
| Space and water heating                           | (261) + (262) + (263) + (264) = |                               |                        | 1910.56                  | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x                         | 0.519                         | =                      | 93.82                    | (267) |
| Electricity for lighting                          | (232) x                         | 0.519                         | =                      | 274.47                   | (268) |
| Energy saving/generation technologies<br>Item 1   |                                 | 0.519                         | =                      | -387.82                  | (269) |
| Total CO2, kg/year                                |                                 |                               | sum of (265)...(271) = | 1891.02                  | (272) |
| Dwelling CO2 Emission Rate                        |                                 |                               | (272) ÷ (4) =          | 12.09                    | (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 459

**Address :** 37 Hopper Road, EASTLEIGH, SO50 9SH

## 1. Overall dwelling dimensions:

|                                                           | Area(m <sup>2</sup> ) | Av. Height(m)                        | Volume(m <sup>3</sup> ) |
|-----------------------------------------------------------|-----------------------|--------------------------------------|-------------------------|
| Ground floor                                              | 78.2 (1a) x           | 2.46 (2a) =                          | 192.37 (3a)             |
| First floor                                               | 78.2 (1b) x           | 2.54 (2b) =                          | 198.63 (3b)             |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 156.4 (4)             |                                      |                         |
| Dwelling volume                                           |                       | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 391 (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) =                               | 0.1 (8)   |
| If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)                              |                                          |           |
| Number of storeys in the dwelling (ns)                                                                                                          |                                          | 0 (9)     |
| Additional infiltration                                                                                                                         | [(9)-1]x0.1 =                            | 0 (10)    |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction                                                        |                                          | 0 (11)    |
| if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35 |                                          |           |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0                                                                   |                                          | 0 (12)    |
| If no draught lobby, enter 0.05, else enter 0                                                                                                   |                                          | 0 (13)    |
| Percentage of windows and doors draught stripped                                                                                                |                                          | 0 (14)    |
| Window infiltration                                                                                                                             | 0.25 - [0.2 x (14) ÷ 100] =              | 0 (15)    |
| Infiltration rate                                                                                                                               | (8) + (10) + (11) + (12) + (13) + (15) = | 0 (16)    |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area                                               |                                          | 5 (17)    |
| If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)                                                        |                                          | 0.35 (18) |
| Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used                                |                                          |           |
| Number of sides sheltered                                                                                                                       |                                          | 2 (19)    |
| Shelter factor                                                                                                                                  | (20) = 1 - [0.075 x (19)] =              | 0.85 (20) |
| Infiltration rate incorporating shelter factor                                                                                                  | (21) = (18) x (20) =                     | 0.3 (21)  |

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

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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

|  |      |      |      |      |      |      |      |      |     |      |      |      |
|--|------|------|------|------|------|------|------|------|-----|------|------|------|
|  | 0.38 | 0.37 | 0.37 | 0.33 | 0.32 | 0.28 | 0.28 | 0.28 | 0.3 | 0.32 | 0.34 | 0.35 |
|--|------|------|------|------|------|------|------|------|-----|------|------|------|

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

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

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

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

if (22b)m < 0.5 × (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 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= 0.57 0.57 0.57 0.55 0.55 0.54 0.54 0.54 0.54 0.55 0.56 0.56 (24d)

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

(25)m= 0.57 0.57 0.57 0.55 0.55 0.54 0.54 0.54 0.54 0.55 0.56 0.56 (25)

## 3. Heat losses and heat loss parameter:

| ELEMENT                    | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m²K        | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K |
|----------------------------|-----------------|-------------|----------------|----------------------|-------------|-----------------|------------|
| Doors Type 1               |                 |             | 2.1            | x 1                  | = 2.1       |                 | (26)       |
| Doors Type 2               |                 |             | 2              | x 1                  | = 2         |                 | (26)       |
| Windows Type 1             |                 |             | 10.55          | x1/[1/( 1.4 )+ 0.04] | = 13.99     |                 | (27)       |
| Windows Type 2             |                 |             | 16.85          | x1/[1/( 1.4 )+ 0.04] | = 22.34     |                 | (27)       |
| Floor                      |                 |             | 78.2           | x 0.13               | = 10.166    |                 | (28)       |
| Walls                      | 185.5           | 31.5        | 154            | x 0.18               | = 27.72     |                 | (29)       |
| Roof                       | 78.2            | 0           | 78.2           | x 0.13               | = 10.17     |                 | (30)       |
| Total area of elements, m² |                 |             | 341.9          |                      |             |                 | (31)       |
| Internal wall **           |                 |             | 220.8          |                      |             |                 | (32c)      |
| Internal wall **           |                 |             | 43             |                      |             |                 | (32c)      |
| Internal floor             |                 |             | 78.2           |                      |             |                 | (32d)      |
| Internal ceiling           |                 |             | 78.2           |                      |             |                 | (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) = 88.48 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 21900.4 (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

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can be used instead of a detailed calculation.

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

13.83 (36)

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

Total fabric heat loss

(33) + (36) =

102.31 (37)

Ventilation heat loss calculated monthly

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

(38)m=

| Jan   | Feb   | Mar  | Apr   | May  | Jun   | Jul   | Aug   | Sep  | Oct  | Nov   | Dec  |
|-------|-------|------|-------|------|-------|-------|-------|------|------|-------|------|
| 73.92 | 73.55 | 73.2 | 71.52 | 71.2 | 69.74 | 69.74 | 69.47 | 70.3 | 71.2 | 71.84 | 72.5 |

(38)

Heat transfer coefficient, W/K

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

(39)m=

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 176.23 | 175.86 | 175.51 | 173.83 | 173.51 | 172.05 | 172.05 | 171.77 | 172.61 | 173.51 | 174.15 | 174.81 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

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

173.82 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=

|      |      |      |      |      |     |     |     |     |      |      |      |
|------|------|------|------|------|-----|-----|-----|-----|------|------|------|
| 1.13 | 1.12 | 1.12 | 1.11 | 1.11 | 1.1 | 1.1 | 1.1 | 1.1 | 1.11 | 1.11 | 1.12 |
|------|------|------|------|------|-----|-----|-----|-----|------|------|------|

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

1.11 (40)

Number of days in month (Table 1a)

(41)m=

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 31  | 28  | 31  | 30  | 31  | 30  | 31  | 31  | 30  | 31  | 30  | 31  |

(41)

## 4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.94

(42)

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

if TFA ≤ 13.9, N = 1

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

104.11

(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=

|        |        |       |        |       |      |      |       |        |       |        |        |
|--------|--------|-------|--------|-------|------|------|-------|--------|-------|--------|--------|
| 114.53 | 110.36 | 106.2 | 102.03 | 97.87 | 93.7 | 93.7 | 97.87 | 102.03 | 106.2 | 110.36 | 114.53 |
|--------|--------|-------|--------|-------|------|------|-------|--------|-------|--------|--------|

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

1249.38 (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=

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 169.84 | 148.54 | 153.28 | 133.64 | 128.23 | 110.65 | 102.53 | 117.66 | 119.06 | 138.76 | 151.46 | 164.48 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

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

1638.13 (45)

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

(46)m=

|       |       |       |       |       |      |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| 25.48 | 22.28 | 22.99 | 20.05 | 19.23 | 16.6 | 15.38 | 17.65 | 17.86 | 20.81 | 22.72 | 24.67 |
|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|

(46)

Water storage loss:

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

150

(47)

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

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

Water storage loss:

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

1.7

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0.92

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

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Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

|      |
|------|
| 0    |
| 0.92 |

(54)

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

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

|        |       |       |       |       |       |       |       |       |       |       |       |       |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| (56)m= | 28.48 | 25.73 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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= | 28.48 | 25.73 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(57)

Primary circuit loss (annual) from Table 3

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

(58)

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

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(59)

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

|        |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|

(61)

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

|        |        |        |        |        |        |        |        |       |        |       |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|-------|--------|--------|
| (62)m= | 221.59 | 195.28 | 205.03 | 183.71 | 179.97 | 160.73 | 154.28 | 169.4 | 169.14 | 190.5 | 201.54 | 216.23 |
|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|-------|--------|--------|

(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= | 221.59 | 195.28 | 205.03 | 183.71 | 179.97 | 160.73 | 154.28 | 169.4 | 169.14 | 190.5 | 201.54 | 216.23 |
|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|-------|--------|--------|

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

2247.4

(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= | 97.87 | 86.78 | 92.36 | 84.5 | 84.03 | 76.85 | 75.49 | 80.52 | 79.65 | 87.53 | 90.42 | 96.09 |
|--------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|

(65)

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

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

Metabolic gains (Table 5), Watts

|        | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| (66)m= | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 | 147.19 |

(66)

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

|        |       |      |       |       |       |       |       |       |       |       |       |       |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| (67)m= | 29.94 | 26.6 | 21.63 | 16.38 | 12.24 | 10.33 | 11.17 | 14.51 | 19.48 | 24.74 | 28.87 | 30.78 |
|--------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(67)

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

|        |       |       |        |        |     |        |        |        |       |        |        |        |
|--------|-------|-------|--------|--------|-----|--------|--------|--------|-------|--------|--------|--------|
| (68)m= | 327.4 | 330.8 | 322.24 | 304.01 | 281 | 259.38 | 244.93 | 241.54 | 250.1 | 268.32 | 291.33 | 312.96 |
|--------|-------|-------|--------|--------|-----|--------|--------|--------|-------|--------|--------|--------|

(68)

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

|        |       |       |       |       |       |       |       |       |       |       |       |       |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| (69)m= | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 | 37.72 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

(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= | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 | -117.75 |
|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

(71)

Water heating gains (Table 5)

|        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| (72)m= | 131.54 | 129.14 | 124.14 | 117.36 | 112.95 | 106.74 | 101.46 | 108.22 | 110.63 | 117.65 | 125.59 | 129.15 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

|        |        |        |        |       |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| (73)m= | 559.05 | 556.69 | 538.17 | 507.9 | 476.35 | 446.61 | 427.72 | 434.43 | 450.36 | 480.87 | 515.95 | 543.04 |
|--------|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|

(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                      | 10.55                  | 19.64            | 0.63           | 0.7            | 63.32 (76)   |
| East         | 0.9x                      | 10.55                  | 38.42            | 0.63           | 0.7            | 123.88 (76)  |
| East         | 0.9x                      | 10.55                  | 63.27            | 0.63           | 0.7            | 204.01 (76)  |
| East         | 0.9x                      | 10.55                  | 92.28            | 0.63           | 0.7            | 297.53 (76)  |
| East         | 0.9x                      | 10.55                  | 113.09           | 0.63           | 0.7            | 364.64 (76)  |
| East         | 0.9x                      | 10.55                  | 115.77           | 0.63           | 0.7            | 373.27 (76)  |
| East         | 0.9x                      | 10.55                  | 110.22           | 0.63           | 0.7            | 355.37 (76)  |
| East         | 0.9x                      | 10.55                  | 94.68            | 0.63           | 0.7            | 305.26 (76)  |
| East         | 0.9x                      | 10.55                  | 73.59            | 0.63           | 0.7            | 237.27 (76)  |
| East         | 0.9x                      | 10.55                  | 45.59            | 0.63           | 0.7            | 146.99 (76)  |
| East         | 0.9x                      | 10.55                  | 24.49            | 0.63           | 0.7            | 78.96 (76)   |
| East         | 0.9x                      | 10.55                  | 16.15            | 0.63           | 0.7            | 52.07 (76)   |
| West         | 0.9x                      | 16.85                  | 19.64            | 0.63           | 0.7            | 101.14 (80)  |
| West         | 0.9x                      | 16.85                  | 38.42            | 0.63           | 0.7            | 197.85 (80)  |
| West         | 0.9x                      | 16.85                  | 63.27            | 0.63           | 0.7            | 325.83 (80)  |
| West         | 0.9x                      | 16.85                  | 92.28            | 0.63           | 0.7            | 475.2 (80)   |
| West         | 0.9x                      | 16.85                  | 113.09           | 0.63           | 0.7            | 582.38 (80)  |
| West         | 0.9x                      | 16.85                  | 115.77           | 0.63           | 0.7            | 596.17 (80)  |
| West         | 0.9x                      | 16.85                  | 110.22           | 0.63           | 0.7            | 567.58 (80)  |
| West         | 0.9x                      | 16.85                  | 94.68            | 0.63           | 0.7            | 487.54 (80)  |
| West         | 0.9x                      | 16.85                  | 73.59            | 0.63           | 0.7            | 378.95 (80)  |
| West         | 0.9x                      | 16.85                  | 45.59            | 0.63           | 0.7            | 234.77 (80)  |
| West         | 0.9x                      | 16.85                  | 24.49            | 0.63           | 0.7            | 126.11 (80)  |
| West         | 0.9x                      | 16.85                  | 16.15            | 0.63           | 0.7            | 83.17 (80)   |

Solar gains in watts, calculated for each month

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

|        |        |        |        |        |        |        |        |       |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|------|
| (83)m= | 164.46 | 321.73 | 529.84 | 772.73 | 947.02 | 969.44 | 922.95 | 792.8 | 616.22 | 381.75 | 205.07 | 135.25 | (83) |
|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|------|

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

|        |        |        |         |         |         |         |         |         |         |        |        |        |      |
|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|--------|--------|--------|------|
| (84)m= | 723.51 | 878.42 | 1068.01 | 1280.63 | 1423.36 | 1416.05 | 1350.67 | 1227.23 | 1066.58 | 862.63 | 721.01 | 678.29 | (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)

|        |     |     |      |      |      |      |      |      |      |      |     |     |      |
|--------|-----|-----|------|------|------|------|------|------|------|------|-----|-----|------|
| (86)m= | Jan | Feb | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov | Dec | (86) |
|        | 1   | 1   | 0.99 | 0.97 | 0.89 | 0.72 | 0.55 | 0.62 | 0.88 | 0.99 | 1   | 1   |      |

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

|        |       |       |      |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (87)m= | 19.66 | 19.82 | 20.1 | 20.48 | 20.79 | 20.95 | 20.99 | 20.98 | 20.85 | 20.42 | 19.97 | 19.64 | (87) |
|--------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

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

|        |       |       |       |       |       |    |    |    |    |       |       |       |      |
|--------|-------|-------|-------|-------|-------|----|----|----|----|-------|-------|-------|------|
| (88)m= | 19.98 | 19.98 | 19.98 | 19.99 | 19.99 | 20 | 20 | 20 | 20 | 19.99 | 19.99 | 19.99 | (88) |
|--------|-------|-------|-------|-------|-------|----|----|----|----|-------|-------|-------|------|

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

|        |   |   |      |      |      |      |      |     |      |      |   |   |      |
|--------|---|---|------|------|------|------|------|-----|------|------|---|---|------|
| (89)m= | 1 | 1 | 0.99 | 0.96 | 0.84 | 0.63 | 0.43 | 0.5 | 0.82 | 0.98 | 1 | 1 | (89) |
|--------|---|---|------|------|------|------|------|-----|------|------|---|---|------|

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

|        |       |       |       |       |       |       |    |       |       |      |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|----|-------|-------|------|-------|-------|------|
| (90)m= | 18.18 | 18.41 | 18.83 | 19.37 | 19.78 | 19.97 | 20 | 19.99 | 19.87 | 19.3 | 18.64 | 18.14 | (90) |
|--------|-------|-------|-------|-------|-------|-------|----|-------|-------|------|-------|-------|------|

|                           |      |      |
|---------------------------|------|------|
| fLA = Living area ÷ (4) = | 0.09 | (91) |
|---------------------------|------|------|

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

|        |       |       |       |       |       |       |       |       |       |      |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|-------|------|
| (92)m= | 18.31 | 18.54 | 18.94 | 19.47 | 19.87 | 20.06 | 20.09 | 20.08 | 19.96 | 19.4 | 18.76 | 18.28 | (92) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|-------|------|

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

|        |       |       |       |       |       |       |       |       |       |      |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|-------|------|
| (93)m= | 18.31 | 18.54 | 18.94 | 19.47 | 19.87 | 20.06 | 20.09 | 20.08 | 19.96 | 19.4 | 18.76 | 18.28 | (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 | 1 | 0.99 | 0.95 | 0.84 | 0.63 | 0.44 | 0.51 | 0.82 | 0.98 | 1 | 1 | (94) |
|--------|---|---|------|------|------|------|------|------|------|------|---|---|------|

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

|        |        |        |         |         |         |        |        |        |        |        |        |        |      |
|--------|--------|--------|---------|---------|---------|--------|--------|--------|--------|--------|--------|--------|------|
| (95)m= | 722.54 | 875.15 | 1053.87 | 1213.21 | 1190.55 | 898.45 | 595.15 | 623.08 | 869.74 | 842.49 | 718.78 | 677.64 | (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= | 2469.47 | 2398.9 | 2183.84 | 1837.26 | 1418.05 | 938.78 | 600.06 | 632.94 | 1011.26 | 1527.33 | 2030.79 | 2461.53 | (97) |
|--------|---------|--------|---------|---------|---------|--------|--------|--------|---------|---------|---------|---------|------|

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

|                                                               |         |         |       |        |        |   |   |   |   |        |        |         |         |      |
|---------------------------------------------------------------|---------|---------|-------|--------|--------|---|---|---|---|--------|--------|---------|---------|------|
| (98)m=                                                        | 1299.71 | 1023.96 | 840.7 | 449.31 | 169.26 | 0 | 0 | 0 | 0 | 509.52 | 944.64 | 1327.22 |         |      |
| Total per year (kWh/year) = Sum(98) <sub>1...5,9...12</sub> = |         |         |       |        |        |   |   |   |   |        |        |         | 6564.32 | (98) |

Space heating requirement in kWh/m²/year

|       |      |
|-------|------|
| 41.97 | (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

|      |       |
|------|-------|
| 93.5 | (206) |
|------|-------|

Efficiency of secondary/supplementary heating system, %

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

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

Space heating requirement (calculated above)

|         |         |       |        |        |   |   |   |   |        |        |         |
|---------|---------|-------|--------|--------|---|---|---|---|--------|--------|---------|
| 1299.71 | 1023.96 | 840.7 | 449.31 | 169.26 | 0 | 0 | 0 | 0 | 509.52 | 944.64 | 1327.22 |
|---------|---------|-------|--------|--------|---|---|---|---|--------|--------|---------|

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

|         |         |        |        |        |   |   |   |   |        |         |         |
|---------|---------|--------|--------|--------|---|---|---|---|--------|---------|---------|
| 1390.06 | 1095.14 | 899.14 | 480.55 | 181.03 | 0 | 0 | 0 | 0 | 544.95 | 1010.31 | 1419.48 |
|---------|---------|--------|--------|--------|---|---|---|---|--------|---------|---------|

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

|         |       |
|---------|-------|
| 7020.66 | (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)

|        |        |        |        |        |        |        |       |        |       |        |        |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|-------|--------|--------|
| 221.59 | 195.28 | 205.03 | 183.71 | 179.97 | 160.73 | 154.28 | 169.4 | 169.14 | 190.5 | 201.54 | 216.23 |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|-------|--------|--------|

Efficiency of water heater

|      |       |
|------|-------|
| 79.8 | (216) |
|------|-------|

## TER WorkSheet: New dwelling as built

(217)m= 

|       |      |       |       |       |      |      |      |      |       |       |       |
|-------|------|-------|-------|-------|------|------|------|------|-------|-------|-------|
| 88.77 | 88.6 | 88.18 | 87.11 | 84.65 | 79.8 | 79.8 | 79.8 | 79.8 | 87.31 | 88.42 | 88.83 |
|-------|------|-------|-------|-------|------|------|------|------|-------|-------|-------|

 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m= 

|        |        |        |       |        |        |        |        |        |        |        |        |
|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| 249.63 | 220.41 | 232.51 | 210.9 | 212.61 | 201.41 | 193.33 | 212.29 | 211.96 | 218.18 | 227.95 | 243.41 |
|--------|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|

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

|         |
|---------|
| 2634.58 |
|---------|

 (219)

### Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

|         |
|---------|
| 7020.66 |
|---------|

Water heating fuel used

|         |
|---------|
| 2634.58 |
|---------|

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

|        |
|--------|
| 528.84 |
|--------|

 (232)

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

|          |
|----------|
| 10259.08 |
|----------|

 (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                         | <table border="1"><tr><td>0.216</td></tr></table> | 0.216 | =                                                         | <table border="1"><tr><td>1516.46</td></tr></table> (261) | 1516.46 |
| 0.216                                             |                                 |                                                   |       |                                                           |                                                           |         |
| 1516.46                                           |                                 |                                                   |       |                                                           |                                                           |         |
| Space heating (secondary)                         | (215) x                         | <table border="1"><tr><td>0.519</td></tr></table> | 0.519 | =                                                         | <table border="1"><tr><td>0</td></tr></table> (263)       | 0       |
| 0.519                                             |                                 |                                                   |       |                                                           |                                                           |         |
| 0                                                 |                                 |                                                   |       |                                                           |                                                           |         |
| Water heating                                     | (219) x                         | <table border="1"><tr><td>0.216</td></tr></table> | 0.216 | =                                                         | <table border="1"><tr><td>569.07</td></tr></table> (264)  | 569.07  |
| 0.216                                             |                                 |                                                   |       |                                                           |                                                           |         |
| 569.07                                            |                                 |                                                   |       |                                                           |                                                           |         |
| Space and water heating                           | (261) + (262) + (263) + (264) = |                                                   |       | <table border="1"><tr><td>2085.53</td></tr></table> (265) | 2085.53                                                   |         |
| 2085.53                                           |                                 |                                                   |       |                                                           |                                                           |         |
| Electricity for pumps, fans and electric keep-hot | (231) x                         | <table border="1"><tr><td>0.519</td></tr></table> | 0.519 | =                                                         | <table border="1"><tr><td>38.93</td></tr></table> (267)   | 38.93   |
| 0.519                                             |                                 |                                                   |       |                                                           |                                                           |         |
| 38.93                                             |                                 |                                                   |       |                                                           |                                                           |         |
| Electricity for lighting                          | (232) x                         | <table border="1"><tr><td>0.519</td></tr></table> | 0.519 | =                                                         | <table border="1"><tr><td>274.47</td></tr></table> (268)  | 274.47  |
| 0.519                                             |                                 |                                                   |       |                                                           |                                                           |         |
| 274.47                                            |                                 |                                                   |       |                                                           |                                                           |         |
| Total CO2, kg/year                                | sum of (265)...(271) =          |                                                   |       | <table border="1"><tr><td>2398.92</td></tr></table> (272) | 2398.92                                                   |         |
| 2398.92                                           |                                 |                                                   |       |                                                           |                                                           |         |

**TER =**

|       |
|-------|
| 15.34 |
|-------|

 (273)