



## SAP Report Submission for Building Regulations Compliance

Client: Highwood Construction Ltd

Project: 92 Highwood Avenue, North Stoneham Park  
EASTLEIGH, SO50 9QZ

Contact: Scott Spearing  
Scott Spearing  
[scott@beatsolutions.co.uk](mailto:scott@beatsolutions.co.uk)

Report Issue Date: 31/01/2023

EXCELLENCE  
IN ENERGY  
ASSESSMENT

# BLOCK COMPLIANCE

## Calculation Type: New Build (As Built)

|                  |                                                                                  |                |            |
|------------------|----------------------------------------------------------------------------------|----------------|------------|
| Block Reference  | SAP-0796 (Stoneham) - 200-208                                                    | Issued on Date | 31/01/2023 |
| Block Name       | 3B4A - Plots 200-208                                                             |                |            |
| Assessor Details | Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk | Assessor ID    | p775-0001  |
| Client           | Highwood Construction Ltd, HIGHWOOD                                              |                |            |

### Block Compliance Report - DER

| Block Reference: SAP-0796 (Stoneham) - 200-208        |            | Block Name: 3B4A - Plots 200-208 |                                          |                                          |           |
|-------------------------------------------------------|------------|----------------------------------|------------------------------------------|------------------------------------------|-----------|
| Property-Assessment Reference                         | Multiplier | Floor Area (m <sup>2</sup> )     | DER (kgCO <sub>2</sub> /m <sup>2</sup> ) | TER (kgCO <sub>2</sub> /m <sup>2</sup> ) | % DER/TER |
| SAP-0796 (3B4A) - Plot 200-AB                         | 1          | 66.3                             | 14.62                                    | 18.48                                    | 20.88 %   |
| SAP-0796 (3B4A) - Plot 201-AB                         | 1          | 47.74                            | 16.37                                    | 19.99                                    | 18.13 %   |
| SAP-0796 (3B4A) - Plot 202-AB                         | 1          | 58.42                            | 15.23                                    | 19.16                                    | 20.50 %   |
| SAP-0796 (3B4A) - Plot 203-AB                         | 1          | 66.3                             | 11.99                                    | 16.40                                    | 26.89 %   |
| SAP-0796 (3B4A) - Plot 204-AB                         | 1          | 47.74                            | 13.19                                    | 17.56                                    | 24.88 %   |
| SAP-0796 (3B4A) - Plot 205-AB                         | 1          | 58.42                            | 11.95                                    | 16.17                                    | 26.11 %   |
| SAP-0796 (3B4A) - Plot 206-AB                         | 1          | 65.03                            | 12.10                                    | 16.10                                    | 24.84 %   |
| SAP-0796 (3B4A) - Plot 207-AB                         | 1          | 47.74                            | 14.69                                    | 19.09                                    | 23.06 %   |
| SAP-0796 (3B4A) - Plot 208-AB                         | 1          | 57.27                            | 12.82                                    | 17.28                                    | 25.80 %   |
| Totals:                                               | 9          | 514.96                           | 122.96                                   | 160.23                                   |           |
| Average DER = 13.57 kgCO <sub>2</sub> /m <sup>2</sup> |            | % DER/TER                        | PASS                                     |                                          |           |
| Average TER = 17.70 kgCO <sub>2</sub> /m <sup>2</sup> |            | 23.33 %                          |                                          |                                          |           |

### Block Compliance Report - DFEE

| Block Reference: SAP-0796 (Stoneham) - 200-208 |            | Block Name: 3B4A - Plots 200-208 |                               |                               |             |
|------------------------------------------------|------------|----------------------------------|-------------------------------|-------------------------------|-------------|
| Property-Assessment Reference                  | Multiplier | Floor Area (m <sup>2</sup> )     | DFEE (kWh/m <sup>2</sup> /yr) | TFEE (kWh/m <sup>2</sup> /yr) | % DFEE/TFEE |
| SAP-0796 (3B4A) - Plot 200-AB                  | 1          | 66.3                             | 40.90                         | 45.37                         | 9.87 %      |
| SAP-0796 (3B4A) - Plot 201-AB                  | 1          | 47.74                            | 44.09                         | 46.90                         | 6.00 %      |
| SAP-0796 (3B4A) - Plot 202-AB                  | 1          | 58.42                            | 43.10                         | 48.06                         | 10.32 %     |
| SAP-0796 (3B4A) - Plot 203-AB                  | 1          | 66.3                             | 29.87                         | 34.36                         | 13.07 %     |
| SAP-0796 (3B4A) - Plot 204-AB                  | 1          | 47.74                            | 31.27                         | 34.56                         | 9.51 %      |
| SAP-0796 (3B4A) - Plot 205-AB                  | 1          | 58.42                            | 29.95                         | 32.84                         | 8.80 %      |
| SAP-0796 (3B4A) - Plot 206-AB                  | 1          | 65.03                            | 30.52                         | 32.85                         | 7.08 %      |
| SAP-0796 (3B4A) - Plot 207-AB                  | 1          | 47.74                            | 37.26                         | 42.33                         | 11.98 %     |
| SAP-0796 (3B4A) - Plot 208-AB                  | 1          | 57.27                            | 33.15                         | 38.10                         | 13.00 %     |
| Totals:                                        | 9          | 514.96                           | 320.10                        | 355.37                        |             |
| Average DFEE = 35.38 kWh/m <sup>2</sup> /yr    |            | % DFEE/TFEE                      | PASS                          |                               |             |
| Average TFEE = 39.30 kWh/m <sup>2</sup> /yr    |            | 9.97 %                           |                               |                               |             |

# BASIC COMPLIANCE REPORT

## Calculation Type: New Build (As Built)

|                                    |                                                                                  |                |                |
|------------------------------------|----------------------------------------------------------------------------------|----------------|----------------|
| Property Reference                 | SAP-0796 (3B4A) - Plot 207                                                       | Issued on Date | 31/01/2023     |
| Assessment Reference               | AB                                                                               | Prop Type Ref  | 1B2P Top Floor |
| Property                           | 92 Highwood Avenue, North Stoneham Park, EASTLEIGH, SO50 9QZ                     |                |                |
| SAP Rating                         | 83 B                                                                             | DER            | 14.69          |
| Environmental                      | 91 B                                                                             | TER            | 19.09          |
| CO <sub>2</sub> Emissions (t/year) | 0.58                                                                             | % DER<TER      | 23.06          |
| General Requirements Compliance    | Pass                                                                             | DFEE           | 37.26          |
|                                    |                                                                                  | TFEE           | 42.33          |
|                                    |                                                                                  | % DFEE<TFEE    | 11.98          |
| Assessor Details                   | Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk |                | Assessor ID    |
|                                    |                                                                                  |                | p775-0001      |
| Client                             | Highwood Construction Ltd, HIGHWOOD                                              |                |                |

### SUMMARY FOR INPUT DATA FOR New Build (As Built)

#### Criterion 1 – Achieving the TER and TFEE rate

##### 1a TER and DER

|                                             |                  |                                   |      |
|---------------------------------------------|------------------|-----------------------------------|------|
| Fuel for main heating                       | Mains gas        |                                   |      |
| Fuel factor                                 | 1.00 (mains gas) |                                   |      |
| Target Carbon Dioxide Emission Rate (TER)   | 19.09            | kgCO <sub>2</sub> /m <sup>2</sup> |      |
| Dwelling Carbon Dioxide Emission Rate (DER) | 14.69            | kgCO <sub>2</sub> /m <sup>2</sup> | Pass |
|                                             | -4.40 (-23.0%)   | kgCO <sub>2</sub> /m <sup>2</sup> |      |

##### 1b TFEE and DFEE

|                                          |               |                        |      |
|------------------------------------------|---------------|------------------------|------|
| Target Fabric Energy Efficiency (TFEE)   | 42.33         | kWh/m <sup>2</sup> /yr |      |
| Dwelling Fabric Energy Efficiency (DFEE) | 37.26         | kWh/m <sup>2</sup> /yr |      |
|                                          | -5.0 (-11.8%) | kWh/m <sup>2</sup> /yr | Pass |

#### Criterion 2 – Limits on design flexibility

##### Limiting Fabric Standards

##### 2 Fabric U-values

| Element       | Average          | Highest          |      |
|---------------|------------------|------------------|------|
| External wall | 0.20 (max. 0.30) | 0.20 (max. 0.70) | Pass |
| Party wall    | 0.00 (max. 0.20) | -                | Pass |
| Roof          | 0.10 (max. 0.20) | 0.18 (max. 0.35) | Pass |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | Pass |

##### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

##### 3 Air permeability

|                                |                                  |      |
|--------------------------------|----------------------------------|------|
| Air permeability at 50 pascals | 3.25 (measured in this dwelling) |      |
| Maximum                        | 10.0                             | Pass |

##### Limiting System Efficiencies

##### 4 Heating efficiency

|                     |                                                                                                                                                                             |      |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Main heating system | Boiler system with radiators or underfloor - Mains gas<br>Data from database<br>Ideal LOGIC COMBI ESP1 35<br>Combi boiler<br>Efficiency: 89.6% SEDBUK2009<br>Minimum: 88.0% | Pass |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|

# BASIC COMPLIANCE REPORT

## Calculation Type: New Build (As Built)

Secondary heating system

None

### 5 Cylinder insulation

Hot water storage

No cylinder

### 6 Controls

Space heating controls

Programmer, room thermostat and TRVs

Pass

Hot water controls

No cylinder

Boiler interlock

Yes

Pass

### 7 Low energy lights

Percentage of fixed lights with low-energy fittings

100

%

Minimum

75

%

Pass

### 8 Mechanical ventilation

Not applicable

## Criterion 3 – Limiting the effects of heat gains in summer

### 9 Summertime temperature

Overheating risk (Southern England)

Slight

Pass

Based on:

Overshading

Average

Windows facing North

3.09 m<sup>2</sup>, No overhang

Windows facing West

4.29 m<sup>2</sup>, No overhang

Air change rate

8.00 ach

Blinds/curtains

None

## Criterion 4 – Building performance consistent with DER and DFEE rate

### Party Walls

Type

U-value

Filled Cavity with Edge Sealing

0.00

W/m<sup>2</sup>K

Pass

### Air permeability and pressure testing

#### 3 Air permeability

Air permeability at 50 pascals

3.25 (measured in this dwelling)

Maximum

10.0

Pass

### 10 Key features

Party wall U-value

0.00

W/m<sup>2</sup>K

Roof U-value

0.10

W/m<sup>2</sup>K

Air permeability

3.3

m<sup>3</sup>/m<sup>2</sup>h

Photovoltaic array

303.48

kWh/Year

*This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.*

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Built)

|                                    |                                                                                  |               |                |      |                |            |
|------------------------------------|----------------------------------------------------------------------------------|---------------|----------------|------|----------------|------------|
| Property Reference                 | SAP-0796 (3B4A) - Plot 207                                                       |               |                |      | Issued on Date | 31/01/2023 |
| Assessment Reference               | AB                                                                               | Prop Type Ref | 1B2P Top Floor |      |                |            |
| Property                           | 92 Highwood Avenue, North Stoneham Park, EASTLEIGH, SO50 9QZ                     |               |                |      |                |            |
|                                    |                                                                                  |               |                |      |                |            |
| SAP Rating                         | 83 B                                                                             | DER           | 14.69          | TER  | 19.09          |            |
| Environmental                      | 91 B                                                                             | % DER<TER     | 23.06          |      |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.58                                                                             | DFEE          | 37.26          | TFEE | 42.33          |            |
| General Requirements Compliance    | Pass                                                                             | % DFEE<TFEE   | 11.98          |      |                |            |
|                                    |                                                                                  |               |                |      |                |            |
| Assessor Details                   | Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk |               |                |      | Assessor ID    | p775-0001  |
| Client                             | Highwood Construction Ltd, HIGHWOOD                                              |               |                |      |                |            |

### SUMMARY FOR INPUT DATA FOR: New Build (As Built)

|                       |                    |
|-----------------------|--------------------|
| Orientation           | East               |
| Property Tenure       | Unknown            |
| Transaction Type      | New dwelling       |
| Terrain Type          | Urban              |
| 1.0 Property Type     | Flat, Mid-Terrace  |
| 2.0 Number of Storeys | 1                  |
| 3.0 Date Built        | 2023               |
| 4.0 Sheltered Sides   | 2                  |
| 5.0 Sunlight/Shade    | Average or unknown |

#### 6.0 Measurements

|               | Heat Loss Perimeter | Internal Floor Area  | Average Storey Height |
|---------------|---------------------|----------------------|-----------------------|
| Ground Floor: | 15.61 m             | 47.74 m <sup>2</sup> | 2.27 m                |

|                 |       |                |
|-----------------|-------|----------------|
| 7.0 Living Area | 25.22 | m <sup>2</sup> |
|-----------------|-------|----------------|

|                            |                     |                     |
|----------------------------|---------------------|---------------------|
| 8.0 Thermal Mass Parameter | Precise calculation |                     |
| Thermal Mass               | 69.59               | kJ/m <sup>2</sup> K |

#### 9.0 External Walls

| Description   | Type         | Construction                                   | U-Value (W/m <sup>2</sup> K) | Kappa (kJ/m <sup>2</sup> K) | Gross Area (m <sup>2</sup> ) | Nett Area (m <sup>2</sup> ) |
|---------------|--------------|------------------------------------------------|------------------------------|-----------------------------|------------------------------|-----------------------------|
| External Wall | Timber Frame | Timber framed wall (one layer of plasterboard) | 0.20                         | 9.00                        | 34.18                        | 26.80                       |

#### 9.1 Party Walls

| Description | Type                            | Construction                                                                       | U-Value (W/m <sup>2</sup> K) | Kappa (kJ/m <sup>2</sup> K) | Area (m <sup>2</sup> ) |
|-------------|---------------------------------|------------------------------------------------------------------------------------|------------------------------|-----------------------------|------------------------|
| Party Wall  | Filled Cavity with Edge Sealing | Double plasterboard on both sides, twin timber f rame with/without sheathing board | 0.00                         | 20.00                       | 29.74                  |

#### 9.2 Internal Walls

| Description    | Construction                 | Kappa (kJ/m <sup>2</sup> K) | Area (m <sup>2</sup> ) |
|----------------|------------------------------|-----------------------------|------------------------|
| Internal Walls | Plasterboard on timber frame | 9.00                        | 69.74                  |

#### 10.0 External Roofs

| Description  | Type                | Construction                             | U-Value (W/m <sup>2</sup> K) | Kappa (kJ/m <sup>2</sup> K) | Gross Area (m <sup>2</sup> ) | Nett Area (m <sup>2</sup> ) |
|--------------|---------------------|------------------------------------------|------------------------------|-----------------------------|------------------------------|-----------------------------|
| Pitched Roof | External Plane Roof | Plasterboard, insulated at ceiling level | 0.10                         | 9.00                        | 44.79                        | 44.79                       |
| Sloping Roof | External Slope Roof | Plasterboard, insulated slope            | 0.16                         | 9.00                        | 1.76                         | 1.76                        |
| Dormer Roof  | External Flat Roof  | Plasterboard, insulated flat roof        | 0.18                         | 9.00                        | 0.81                         | 0.81                        |

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Built)

### 11.1 Party Floors

| Description | Construction              | Kappa (kJ/m²K) | Area (m²) |
|-------------|---------------------------|----------------|-----------|
| Party Floor | Timber I-joists, carpeted | 30.00          | 47.74     |

### 12.0 Opening Types

| Description | Data Source   | Type   | Glazing                | Glazing Gap | Argon Filled | G-value | Frame Type | Frame Factor | U Value (W/m²K) |
|-------------|---------------|--------|------------------------|-------------|--------------|---------|------------|--------------|-----------------|
| Windows     | Manufacture r | Window | Double Low-E Soft 0.05 |             |              | 0.63    |            | 0.70         | 1.40            |

### 13.0 Openings

| Name  | Opening Type | Location          | Orientation | Curtain Type | Overhang Ratio | Wide Overhang | Width (m) | Height (m) | Count | Area (m²) | Curtain Closed |
|-------|--------------|-------------------|-------------|--------------|----------------|---------------|-----------|------------|-------|-----------|----------------|
| West  | Window       | [1] External Wall | West        | None         | 0.00           |               |           |            |       | 4.29      |                |
| North | Window       | [1] External Wall | North       | None         | 0.00           |               |           |            |       | 3.09      |                |

### 14.0 Conservatory

None

### 15.0 Draught Proofing

100

%

### 16.0 Draught Lobby

No

### 17.0 Thermal Bridging

Calculate Bridges

### 17.1 List of Bridges

| Source Type         | Bridge Type                                                               | Length | Psi    | Imported |
|---------------------|---------------------------------------------------------------------------|--------|--------|----------|
| Table K1 - Approved | E2 Other lintels (including other steel lintels)                          | 5.68   | 0.300  | Yes      |
| Table K1 - Approved | E3 Sill                                                                   | 5.68   | 0.040  | Yes      |
| Table K1 - Approved | E4 Jamb                                                                   | 13.00  | 0.050  | Yes      |
| Table K1 - Approved | E7 Party floor between dwellings (in blocks of flats)                     | 15.61  | 0.070  | Yes      |
| Table K1 - Approved | E16 Corner (normal)                                                       | 7.05   | 0.090  | No       |
| Table K1 - Approved | E17 Corner (inverted – internal area greater than external area)          | 2.35   | -0.090 | No       |
| Table K1 - Approved | E18 Party wall between dwellings                                          | 1.80   | 0.060  | No       |
| Table K1 - Default  | E25 Staggered party wall between dwellings                                | 2.35   | 0.120  | No       |
| Table K1 - Default  | P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 13.20  | 0.000  | No       |
| Table K1 - Default  | P4 Party wall - Roof (insulation at ceiling level)                        | 12.04  | 0.240  | No       |
| Table K1 - Default  | P5 Party wall - Roof (insulation at rafter level)                         | 1.20   | 0.080  | No       |

|         |       |       |
|---------|-------|-------|
| Y-value | 0.092 | W/m²K |
|---------|-------|-------|

### 18.0 Pressure Testing

|                           |      |                   |
|---------------------------|------|-------------------|
| Designed AP <sub>50</sub> | Yes  |                   |
| Property Tested ?         | 6.00 | m³/(h.m²) @ 50 Pa |
| As Built AP <sub>50</sub> | Yes  |                   |
|                           | 3.25 | m³/(h.m²) @ 50 Pa |

### 19.0 Mechanical Ventilation

#### Summer Overheating

|                             |                    |
|-----------------------------|--------------------|
| Windows open in hot weather | Windows fully open |
| Cross ventilation possible  | Yes                |
| Night Ventilation           | Yes                |
| Air change rate             | 8.00               |

#### Mechanical Ventilation

|                                       |    |
|---------------------------------------|----|
| Mechanical Ventilation System Present | No |
|---------------------------------------|----|

### 20.0 Fans, Open Fireplaces, Flues

|                             | MHS | SHS | Other | Total |
|-----------------------------|-----|-----|-------|-------|
| Number of Chimneys          | 0   |     | 0     | 0     |
| Number of open flues        | 0   |     | 0     | 0     |
| Number of intermittent fans |     |     |       | 2     |

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Built)

Number of passive vents 0  
Number of flueless gas fires 0

**21.0 Fixed Cooling System** No

### 22.0 Lighting

#### Internal

Total number of light fittings 7  
Total number of L.E.L. fittings 7  
Percentage of L.E.L. fittings 100.00 %

#### External

External lights fitted No

**23.0 Electricity Tariff** Standard

**24.0 Main Heating 1** Database

Description Gas Boiler  
Percentage of Heat 100 %  
Database Ref. No. 17929  
Fuel Type Mains gas  
Main Heating BGW  
SAP Code 104  
In Winter 90.5  
In Summer 87.3  
Controls CBE Programmer, room thermostat and TRVs  
PCDF Controls 0  
Delayed Start Stat No  
Sap Code 2106  
Flue Type Balanced  
Fan Assisted Flue Yes  
Is MHS Pumped Pump in heated space  
Heat Emitter Radiators  
Flow Temperature Normal (> 45°C)  
Combi boiler type Standard Combi  
Combi keep hot type None

**25.0 Main Heating 2** None

Community Heating None

**28.0 Water Heating** HWP From main heating 1

Water Heating Main Heating 1  
Flue Gas Heat Recovery System No  
Waste Water Heat Recovery Instantaneous System 1 No  
Waste Water Heat Recovery Instantaneous System 2 No  
Waste Water Heat Recovery Storage System No  
Solar Panel No  
Water use <= 125 litres/person/day Yes

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Built)

|                         |                           |
|-------------------------|---------------------------|
| SAP Code                | 901                       |
| 29.0 Hot Water Cylinder | None                      |
| 32.0 Photovoltaic Unit  | More Dwellings, One Block |
| Apportioned             | 303.48                    |

kWh/Year

### Recommendations

#### Lower cost measures

None

#### Further measures to achieve even higher standards

None

# U-VALUE CALCULATOR REPORT

|                      |                                                              |                |                |
|----------------------|--------------------------------------------------------------|----------------|----------------|
| Property Reference   | SAP-0796 (3B4A) - Plot 207                                   | Issued on Date | 31/01/2023     |
| Assessment Reference | AB                                                           | Prop Type Ref  | 1B2P Top Floor |
| Project              | 92 Highwood Avenue, North Stoneham Park, EASTLEIGH, SO50 9QZ |                |                |
| Calculation Type     | New Build (As Built)                                         |                |                |

|                                    |      |             |       |      |       |
|------------------------------------|------|-------------|-------|------|-------|
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| CO <sub>2</sub> Emissions (t/year) | 0.58 | DFEE        | 37.26 | TFEE | 42.33 |
| General Requirements Compliance    | Pass | % DFEE<TFEE | 11.98 |      |       |

|                  |                                                                                     |             |           |
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| Client           | Highwood Construction Ltd, HIGHWOOD                                                 |             |           |

## Building Elements

### Roof Pitched Roof

#### Roof Type: Pitched Roof, insulated flat ceiling

| Layer       | Description                                                | Thickness (mm) | Conductivity (W/m <sup>2</sup> K) | Resistance (m <sup>2</sup> K/W) | Fraction (%) |
|-------------|------------------------------------------------------------|----------------|-----------------------------------|---------------------------------|--------------|
| Ext surface |                                                            |                |                                   | 0.0400                          |              |
| Layer 1     | <b>Mineral wool</b>                                        |                |                                   |                                 |              |
|             | Main construction                                          | 200            | 0.0400                            | 5.0000                          | 100.00       |
|             | Corrections - Air Gap: Level 0, Fasteners: None or plastic |                |                                   |                                 |              |
| Layer 2     | <b>Mineral wool</b>                                        |                |                                   |                                 |              |
|             | Main construction                                          | 200            | 0.0400                            | 5.0000                          | 91.67        |
|             | Main construction                                          | 200            | 0.1300                            | 1.5385                          | 8.33         |
|             | Corrections - Air Gap: Level 1, Fasteners: None or plastic |                |                                   |                                 |              |
| Layer 3     | <b>Plasterboard, standard</b>                              |                |                                   |                                 |              |
|             | Main construction                                          | 12.5           | 0.2100                            | 0.0595                          | 100.00       |
| Layer 4     | <b>Plaster, standard</b>                                   |                |                                   |                                 |              |
|             | Main construction                                          | 3              | 0.4000                            | 0.0075                          | 100.00       |
| Int surface |                                                            |                |                                   | 0.1000                          |              |

|                   |                                              |                                              |                                    |
|-------------------|----------------------------------------------|----------------------------------------------|------------------------------------|
| Total resistance: | Upper limit = 9.788 m <sup>2</sup> K/W       | Lower limit = 9.418 m <sup>2</sup> K/W       | Average = 9.603 m <sup>2</sup> K/W |
|                   | Total correction = 0.0019 m <sup>2</sup> K/W | U-value (unrounded) = 0.1 W/m <sup>2</sup> K |                                    |

Unheated space: None

Total thickness: 416 mm

U-value: 0.10 W/m<sup>2</sup> K

Kappa: n/a

# U-VALUE CALCULATOR REPORT

|                      |                                                              |               |                |            |
|----------------------|--------------------------------------------------------------|---------------|----------------|------------|
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|                                    |      |             |       |      |       |
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| CO <sub>2</sub> Emissions (t/year) | 0.58 | DFEE        | 37.26 | TFEE | 42.33 |
| General Requirements Compliance    | Pass | % DFEE<TFEE | 11.98 |      |       |

|                  |                                                                                     |             |           |
|------------------|-------------------------------------------------------------------------------------|-------------|-----------|
| Assessor Details | Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920,<br>scott@beatsolutions.co.uk | Assessor ID | A808-0004 |
|------------------|-------------------------------------------------------------------------------------|-------------|-----------|

|        |                                     |
|--------|-------------------------------------|
| Client | Highwood Construction Ltd, HIGHWOOD |
|--------|-------------------------------------|

## Building Elements

### Wall External Walls - Stoneham - TF

Wall Type: Timber framed Wall with I-beams

# U-VALUE CALCULATOR REPORT

| Layer       | Description                                                | Thickness<br>(mm) | Conductivity<br>(W/m²K) | Resistance<br>(m²K/W) | Fraction<br>(%) |
|-------------|------------------------------------------------------------|-------------------|-------------------------|-----------------------|-----------------|
| Ext surface |                                                            |                   |                         | 0.2900                |                 |
| Layer 1     | <b>Brick, outer leaf</b>                                   |                   |                         |                       |                 |
|             | Main construction                                          | 100               | 0.7700                  | 0.0000                | 82.81           |
|             | Main construction                                          | 100               | 0.9407                  | 0.0000                | 17.19           |
| Layer 2     | <b>Standard cavity</b>                                     |                   |                         |                       |                 |
|             | Main construction                                          | 50                | 0.0000                  | 0.0000                | 100.00          |
|             | Corrections - Cavity Ventilated, Emissivity: Low           |                   |                         |                       |                 |
|             | Emissivity (BR443)                                         |                   |                         |                       |                 |
| Layer 3     | <b>Breather membrane</b>                                   |                   |                         |                       |                 |
|             | Main construction                                          | 1                 | 0.0000                  | 0.0000                | 100.00          |
| Layer 4     | <b>Orientated Strand Board</b>                             |                   |                         |                       |                 |
|             | Main construction                                          | 9                 | 0.1300                  | 0.0692                | 100.00          |
| Layer 5     | <b>Timber Frame Void</b>                                   |                   |                         |                       |                 |
|             | Main construction                                          | 20                | 0.1143                  | 0.1750                | 92.17           |
|             | Main construction                                          | 20                | 0.1300                  | 0.1538                | 7.83            |
|             | Corrections - Cavity Unventilated, Emissivity: Low         |                   |                         |                       |                 |
|             | Emissivity (BR443)                                         |                   |                         |                       |                 |
| Layer 6     | <b>Celotex GA4000</b>                                      |                   |                         |                       |                 |
|             | Main construction                                          | 100               | 0.0220                  | 4.5455                | 92.17           |
|             | Main construction                                          | 100               | 0.1300                  | 0.7692                | 7.83            |
|             | Corrections - Air Gap: Level 1, Fasteners: None or plastic |                   |                         |                       |                 |
| Layer 7     | <b>Timber Frame Void</b>                                   |                   |                         |                       |                 |
|             | Main construction                                          | 20                | 0.1143                  | 0.1750                | 92.17           |
|             | Main construction                                          | 20                | 0.1300                  | 0.1538                | 7.83            |
|             | Corrections - Cavity Unventilated, Emissivity: Low         |                   |                         |                       |                 |
|             | Emissivity (BR443)                                         |                   |                         |                       |                 |
| Layer 8     | <b>Polythene, 500 gauge</b>                                |                   |                         |                       |                 |
|             | Main construction                                          | 1                 | 0.0000                  | 0.0000                | 100.00          |
| Layer 9     | <b>Service Void</b>                                        |                   |                         |                       |                 |
|             | Main construction                                          | 25                | 0.0321                  | 0.7800                | 89.63           |
|             | Main construction                                          | 25                | 0.1300                  | 0.1923                | 10.37           |
|             | Corrections - Cavity Unventilated, Emissivity: Normal      |                   |                         |                       |                 |
| Layer 10    | <b>Plasterboard, standard</b>                              |                   |                         |                       |                 |
|             | Main construction                                          | 12.5              | 0.2100                  | 0.0595                | 100.00          |
| Layer 11    | <b>Plaster, standard</b>                                   |                   |                         |                       |                 |
|             | Main construction                                          | 3                 | 0.4000                  | 0.0075                | 100.00          |
| Int surface |                                                            |                   |                         | 0.1300                |                 |

Total resistance:    **Upper limit** = 5.477 m² K/W      **Lower limit** = 4.778 m² K/W      **Average** = 5.128 m² K/W  
**Total correction** = 0.0041 m² K/W      **U-value (unrounded)** = 0.2 W/m² K

Unheated space:    None

**Total thickness: 342 mm**

**U-value: 0.20 W/m² K**

**Kappa: n/a**

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

|                                    |                                                                                  |               |                |                |            |
|------------------------------------|----------------------------------------------------------------------------------|---------------|----------------|----------------|------------|
| Property Reference                 | SAP-0796 (3B4A) - Plot 207                                                       |               |                | Issued on Date | 31/01/2023 |
| Assessment Reference               | AB                                                                               | Prop Type Ref | 1B2P Top Floor |                |            |
| Property                           | 92 Highwood Avenue, North Stoneham Park, EASTLEIGH, SO50 9QZ                     |               |                |                |            |
|                                    |                                                                                  |               |                |                |            |
| SAP Rating                         | 83 B                                                                             | DER           | 14.69          | TER            | 19.09      |
| Environmental                      | 91 B                                                                             | % DER<TER     | 23.06          |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.58                                                                             | DFEE          | 37.26          | TFEE           | 42.33      |
| General Requirements Compliance    | Pass                                                                             | % DFEE<TFEE   | 11.98          |                |            |
|                                    |                                                                                  |               |                |                |            |
| Assessor Details                   | Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk |               |                | Assessor ID    | p775-0001  |
| Client                             | Highwood Construction Ltd, HIGHWOOD                                              |               |                |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS BUILT

Top-floor flat, total floor area 48 m<sup>2</sup>

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:Mains gas  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 19.09 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.69 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 42.3 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 37.3 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.20 (max. 0.30) | 0.20 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.10 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (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: 3.25 (measured in this dwelling)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas  
Data from database  
Ideal LOGIC COMBI ESP1 35  
Combi boiler  
Efficiency: 89.6% SEDBUK2009  
Minimum: 88.0% OK

#### Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage No cylinder

#### 6 Controls

Space heating controls: Programmer, room thermostat and TRVs OK

#### Hot water controls:

No cylinder

#### Boiler interlock

Yes

OK

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Not applicable

#### 9 Summertime temperature

Overheating risk (Southern England): Slight OK  
Based on:  
Overshading: Average  
Windows facing North: 3.09 m<sup>2</sup>, No overhang  
Windows facing West: 4.29 m<sup>2</sup>, No overhang  
Air change rate: 8.00 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Roof U-value 0.10 W/m<sup>2</sup>K  
Air permeability 3.3 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 303.48 kWh/Year

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 47.7400 (1b)              | x 2.2700 (2b)                   | = 108.3698 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 47.7400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 108.3698 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total    | m <sup>3</sup> per hour |
|------------------------------------------------------|------------------------------|----------------------|-------|----------|-------------------------|
| Number of chimneys                                   | 0                            | 0                    | 0     | 0 * 40 = | 0.0000 (6a)             |
| Number of open flues                                 | 0                            | 0                    | 0     | 0 * 20 = | 0.0000 (6b)             |
| Number of intermittent fans                          |                              |                      |       | 2 * 10 = | 20.0000 (7a)            |
| Number of passive vents                              |                              |                      |       | 0 * 10 = | 0.0000 (7b)             |
| Number of flueless gas fires                         |                              |                      |       | 0 * 40 = | 0.0000 (7c)             |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |          | Air changes per hour    |
| Pressure test                                        |                              |                      |       |          | 20.0000 / (5) =         |
| Measured/design AP50                                 |                              |                      |       |          | Yes                     |
| Infiltration rate                                    |                              |                      |       |          | 3.2500                  |
| Number of sides sheltered                            |                              |                      |       |          | 0.3471 (18)             |
|                                                      |                              |                      |       |          | 2 (19)                  |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |          | 0.8500 (20)             |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |          | 0.2950 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3761 | 0.3687 | 0.3614 | 0.3245 | 0.3171 | 0.2802 | 0.2802 | 0.2729 | 0.2950 | 0.3171 | 0.3319 | 0.3466 (22b) |
| Effective ac    | 0.5707 | 0.5680 | 0.5653 | 0.5526 | 0.5503 | 0.5393 | 0.5393 | 0.5372 | 0.5435 | 0.5503 | 0.5551 | 0.5601 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| Windows (Uw = 1.40)                                            |                         |                            | 7.3800                    | 1.3258                        | 9.7841       |                                      | (27)            |
| External Wall                                                  | 34.1800                 | 7.3800                     | 26.8000                   | 0.2000                        | 5.3600       | 9.0000                               | 241.2000 (29a)  |
| Pitched Roof                                                   | 44.7900                 |                            | 44.7900                   | 0.1000                        | 4.4790       | 9.0000                               | 403.1100 (30)   |
| Sloping Roof                                                   | 1.7600                  |                            | 1.7600                    | 0.1600                        | 0.2816       | 9.0000                               | 15.8400 (30)    |
| Dormer Roof                                                    | 0.8100                  |                            | 0.8100                    | 0.1800                        | 0.1458       | 9.0000                               | 7.2900 (30)     |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 81.5400                   |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 20.0505      |                                      | (33)            |
| Party Wall                                                     |                         |                            | 29.7400                   | 0.0000                        | 0.0000       | 20.0000                              | 594.8000 (32)   |
| Party Floor                                                    |                         |                            | 47.7400                   |                               |              | 30.0000                              | 1432.2000 (32d) |
| Internal Walls                                                 |                         |                            | 69.7400                   |                               |              | 9.0000                               | 627.6600 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 3322.1000 (34)  |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 69.5873 (35)    |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 7.4725 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 27.5230 (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                     | 20.4106 | 20.3123 | 20.2161 | 19.7638 | 19.6792 | 19.2853 | 19.2853 | 19.2124 | 19.4371 | 19.6792 | 19.8504 | 20.0293 (38) |
| Heat transfer coeff       | 47.9336 | 47.8353 | 47.7390 | 47.2868 | 47.2022 | 46.8083 | 46.8083 | 46.7354 | 46.9601 | 47.2022 | 47.3734 | 47.5523 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 47.2864 (39) |
| HLP                       | 1.0041  | 1.0020  | 1.0000  | 0.9905  | 0.9887  | 0.9805  | 0.9805  | 0.9790  | 0.9837  | 0.9887  | 0.9923  | 0.9961 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.9905 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |         |         |         |         |         |         |                    |          |                |
|------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                        |          |          |          |         |         |         |         |         |         |                    |          | 1.6238 (42)    |
| Average daily hot water use (litres/day) |          |          |          |         |         |         |         |         |         |                    |          | 72.7658 (43)   |
| Daily hot water use                      | 80.0424  | 77.1317  | 74.2211  | 71.3105 | 68.3998 | 65.4892 | 65.4892 | 68.3998 | 71.3105 | 74.2211            | 77.1317  | 80.0424 (44)   |
| Energy conte                             | 118.7005 | 103.8162 | 107.1290 | 93.3977 | 89.6173 | 77.3329 | 71.6603 | 82.2313 | 83.2134 | 96.9772            | 105.8582 | 114.9551 (45)  |
| Energy content (annual)                  |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1144.8892 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 17.8051  | 15.5724  | 16.0694  | 14.0097 | 13.4426 | 11.5999 | 10.7490 | 12.3347 | 12.4820 | 14.5466            | 15.8787  | 17.2433 (46)   |
| Water storage loss:                      |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |         |         |         |         |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|---------------|
| Total storage loss                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000 (56)   |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000 (57)   |
| Combi loss                                                      | 13.9846  | 12.6175  | 13.9474  | 13.4726  | 13.9037  | 13.4343 | 13.8692 | 13.8916 | 13.4552 | 13.9293  | 13.5088  | 13.9774 (61)  |
| Total heat required for water heating calculated for each month | 132.6851 | 116.4337 | 121.0764 | 106.8703 | 103.5210 | 90.7673 | 85.5295 | 96.1228 | 96.6686 | 110.9065 | 119.3669 | 128.9325 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 132.6851 | 116.4337 | 121.0764 | 106.8703 | 103.5210 | 90.7673 | 85.5295 | 96.1228 | 96.6686 | 110.9065 | 119.3669 | 128.9325 (64) |
| Heat gains from water heating, kWh/month                        | 42.9641  | 37.6733  | 39.1073  | 34.4229  | 33.2737  | 29.0718 | 27.2944 | 30.8148 | 31.0323 | 35.7272  | 38.5750  | 41.7169 (65)  |

#### 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                                                                               | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.2397  | 11.7594  | 9.5634   | 7.2401   | 5.4121   | 4.5691   | 4.9371   | 6.4174   | 8.6134   | 10.9367  | 12.7647  | 13.6077 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 141.3672 | 142.8341 | 139.1374 | 131.2677 | 121.3335 | 111.9968 | 105.7593 | 104.2924 | 107.9890 | 115.8588 | 125.7930 | 135.1297 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 (71) |
| Water heating gains (Table 5)                                                       | 57.7474  | 56.0614  | 52.5635  | 47.8096  | 44.7227  | 40.3775  | 36.6860  | 41.4177  | 43.1003  | 48.0205  | 53.5764  | 56.0711 (72)  |
| Total internal gains                                                                | 262.7116 | 261.0122 | 251.6217 | 236.6747 | 221.8256 | 207.3007 | 197.7397 | 202.4848 | 210.0601 | 225.1733 | 242.4914 | 255.1658 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m <sup>2</sup> | Solar flux<br>Table 6a<br>W/m <sup>2</sup> | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |               |
|-------------|----------|----------|----------|----------|------------------------|--------------------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|---------------|
| North       |          |          |          |          | 3.0900                 | 10.6334                                    | 0.6300                            | 0.7000                             | 0.7700                       | 10.0416 (74) |          |               |
| West        |          |          |          |          | 4.2900                 | 19.6403                                    | 0.6300                            | 0.7000                             | 0.7700                       | 25.7500 (80) |          |               |
| -----       |          |          |          |          |                        |                                            |                                   |                                    |                              |              |          |               |
| Solar gains | 35.7915  | 69.5623  | 115.5646 | 173.3641 | 218.8309               | 227.3181                                   | 215.0253                          | 180.0765                           | 135.6873                     | 29.5467 (83) |          |               |
| Total gains | 298.5031 | 330.5746 | 367.1863 | 410.0388 | 440.6565               | 434.6188                                   | 412.7650                          | 382.5613                           | 345.7475                     | 307.7875     | 286.9862 | 284.7125 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 19.2518 | 19.2913 | 19.3302 | 19.5151 | 19.5500 | 19.7146 | 19.7146 | 19.7453 | 19.6509                   | 19.5500 | 19.4794 | 19.4061      |
| alpha                                                                       | 2.2835  | 2.2861  | 2.2887  | 2.3010  | 2.3033  | 2.3143  | 2.3143  | 2.3164  | 2.3101                    | 2.3033  | 2.2986  | 2.2937       |
| util living area                                                            | 0.9314  | 0.9120  | 0.8744  | 0.8027  | 0.6959  | 0.5615  | 0.4434  | 0.4859  | 0.6749                    | 0.8381  | 0.9106  | 0.9375 (86)  |
| MIT                                                                         | 18.4491 | 18.7096 | 19.1845 | 19.8060 | 20.3495 | 20.7260 | 20.8868 | 20.8564 | 20.5532                   | 19.8547 | 19.0506 | 18.3934 (87) |
| Th 2                                                                        | 20.0800 | 20.0817 | 20.0833 | 20.0913 | 20.0927 | 20.0996 | 20.0996 | 20.1009 | 20.0970                   | 20.0927 | 20.0897 | 20.0866 (88) |
| util rest of house                                                          | 0.9240  | 0.9025  | 0.8605  | 0.7801  | 0.6594  | 0.5051  | 0.3673  | 0.4097  | 0.6237                    | 0.8145  | 0.8995  | 0.9308 (89)  |
| MIT 2                                                                       | 17.7336 | 17.9907 | 18.4570 | 19.0629 | 19.5736 | 19.9125 | 20.0394 | 20.0207 | 19.7719                   | 19.1224 | 18.3363 | 17.6834 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.5283 (91)  |
| MIT                                                                         | 18.1116 | 18.3705 | 18.8413 | 19.4555 | 19.9835 | 20.3423 | 20.4870 | 20.4622 | 20.1846                   | 19.5092 | 18.7136 | 18.0585 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.1116 | 18.3705 | 18.8413 | 19.4555 | 19.9835 | 20.3423 | 20.4870 | 20.4622 | 20.1846                   | 19.5092 | 18.7136 | 18.0585 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 0.9039   | 0.8808   | 0.8381   | 0.7622   | 0.6546   | 0.5210   | 0.4012   | 0.4416   | 0.6291   | 0.7969       | 0.8786   | 0.9116 (94)    |
| Ext temp.            | 269.8169 | 291.1747 | 307.7559 | 312.5314 | 288.4664 | 226.4497 | 165.5810 | 168.9300 | 217.5056 | 245.2876     | 252.1594 | 259.5372 (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Month fracti         | 662.0372 | 644.3656 | 589.1621 | 499.1341 | 390.9993 | 268.7864 | 181.9463 | 189.8476 | 285.7351 | 420.5361     | 550.1763 | 659.0025 (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating        | 291.8120 | 237.3443 | 209.3662 | 134.3539 | 76.2845  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 130.3849     | 214.5722 | 297.2022 (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 1591.3202 (98) |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 33.3331 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

|                                                                       |          |          |          |          |          |          |         |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |         |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |         |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |         |          |          |          |          |           | 90.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |         |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |         |          |          |          |          |           | 1758.3648 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 291.8120 | 237.3443 | 209.3662 | 134.3539 | 76.2845  | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 130.3849 | 214.5722 | 297.2022  | (98)            |
| Space heating efficiency (main heating system 1)                      | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 90.5000  | 90.5000  | 90.5000   | (210)           |
| Space heating fuel (main heating system)                              | 322.4442 | 262.2589 | 231.3439 | 148.4574 | 84.2923  | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 144.0717 | 237.0963 | 328.4002  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 132.6851 | 116.4337 | 121.0764 | 106.8703 | 103.5210 | 90.7673  | 85.5295 | 96.1228  | 96.6686  | 110.9065 | 119.3669 | 128.9325  | (64)            |
| Efficiency of water heater (217)m                                     | 89.4749  | 89.4212  | 89.3006  | 89.0538  | 88.6296  | 87.3000  | 87.3000 | 87.3000  | 87.3000  | 89.0005  | 89.3296  | 87.3000   | (216)           |
| Fuel for water heating, kWh/month                                     | 148.2932 | 130.2081 | 135.5830 | 120.0065 | 116.8019 | 103.9717 | 97.9720 | 110.1063 | 110.7315 | 124.6133 | 133.6253 | 144.0469  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |         |          |          |          |          | 1475.9595 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |         |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |         |          |          |          |          | 1758.3648 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |         |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |         |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |         |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |         |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |         |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |         |          |          |          |          | 233.8175  | (232)           |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |          |          |         |          |          |          |          |           |                 |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |         |          |          |          |          | 3543.1418 | (238)           |

#### 12a. Carbon dioxide 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               | 1758.3648          | 0.2160                        | 379.8068                 | (261) |
| Space heating - secondary                   | 0.0000             | 0.0000                        | 0.0000                   | (263) |
| Water heating (other fuel)                  | 1475.9595          | 0.2160                        | 318.8073                 | (264) |
| Space and water heating                     |                    |                               | 698.6141                 | (265) |
| Pumps and fans                              | 75.0000            | 0.5190                        | 38.9250                  | (267) |
| Energy for lighting                         | 233.8175           | 0.5190                        | 121.3513                 | (268) |
| Energy saving/generation technologies       |                    |                               |                          |       |
| PV Unit                                     | -303.4800          | 0.5190                        | -157.5061                | (269) |
| Total CO2, kg/year                          |                    |                               | 701.3842                 | (272) |
| Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 14.6900                  | (273) |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |  |     |         |     |
|---------------------------------------------------------------------------------|--|-----|---------|-----|
| DER                                                                             |  |     | 14.6900 | ZC1 |
| Total Floor Area                                                                |  | TFA | 47.7400 |     |
| Assumed number of occupants                                                     |  | N   | 1.6238  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             |  | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |  |     | 17.5474 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |  |     | 3.3090  | ZC3 |
| Total CO2 emissions                                                             |  |     | 35.5464 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |  |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |  |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |  |     | 35.5464 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 47.7400 (1b)              | x 2.2700 (2b)                   | = 108.3698 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 47.7400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 108.3698 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
|                                                                           |                 |                      |       |       | Air changes per hour                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1846 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.4346 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 2 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3694 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.4709 | 0.4617 | 0.4525 | 0.4063 | 0.3971 | 0.3509 | 0.3509 | 0.3417 | 0.3694 | 0.3971 | 0.4155 | 0.4340 (22b) |
| Effective ac    | 0.6109 | 0.6066 | 0.6024 | 0.5825 | 0.5788 | 0.5616 | 0.5616 | 0.5584 | 0.5682 | 0.5788 | 0.5863 | 0.5942 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                 | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|------------------------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 7.3800                    | 1.3258                        | 9.7841                       |                                | (27)          |
| External Wall                                                  | 34.1800                 | 7.3800                     | 26.8000                   | 0.1800                        | 4.8240                       |                                | (29a)         |
| Pitched Roof                                                   | 44.7900                 |                            | 44.7900                   | 0.1300                        | 5.8227                       |                                | (30)          |
| Sloping Roof                                                   | 1.7600                  |                            | 1.7600                    | 0.1300                        | 0.2288                       |                                | (30)          |
| Dormer Roof                                                    | 0.8100                  |                            | 0.8100                    | 0.1300                        | 0.1053                       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 81.5400                   |                               |                              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           |                               | (26)...(30) + (32) = 20.7649 |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |                              |                                | 4.5235 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |                              | (33) + (36) =                  | 25.2884 (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                     | 21.8469 | 21.6929 | 21.5419 | 20.8329 | 20.7003 | 20.0827 | 20.0827 | 19.9684 | 20.3206 | 20.7003 | 20.9686 | 21.2492 (38) |
| Heat transfer coeff       | 47.1353 | 46.9813 | 46.8303 | 46.1213 | 45.9887 | 45.3711 | 45.3711 | 45.2568 | 45.6090 | 45.9887 | 46.2570 | 46.5376 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 46.1207 (39) |
| HLP                       | 0.9873  | 0.9841  | 0.9809  | 0.9661  | 0.9633  | 0.9504  | 0.9504  | 0.9480  | 0.9554  | 0.9633  | 0.9689  | 0.9748 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.9661 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                              |          |          |          |         |         |         |         |         |         |         |          |                                   |
|----------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|---------|----------|-----------------------------------|
| Assumed occupancy                            |          |          |          |         |         |         |         |         |         |         |          | 1.6238 (42)                       |
| Average daily hot water use (litres/day)     |          |          |          |         |         |         |         |         |         |         |          | 72.7658 (43)                      |
| Daily hot water use                          | 80.0424  | 77.1317  | 74.2211  | 71.3105 | 68.3998 | 65.4892 | 65.4892 | 68.3998 | 71.3105 | 74.2211 | 77.1317  | 80.0424 (44)                      |
| Energy conte                                 | 118.7005 | 103.8162 | 107.1290 | 93.3977 | 89.6173 | 77.3329 | 71.6603 | 82.2313 | 83.2134 | 96.9772 | 105.8582 | 114.9551 (45)                     |
| Energy content (annual)                      |          |          |          |         |         |         |         |         |         |         |          | Total = Sum(45)m = 1144.8892 (45) |
| Distribution loss (46)m = 0.15 x (45)m       | 17.8051  | 15.5724  | 16.0694  | 14.0097 | 13.4426 | 11.5999 | 10.7490 | 12.3347 | 12.4820 | 14.5466 | 15.8787  | 17.2433 (46)                      |
| Water storage loss:                          |          |          |          |         |         |         |         |         |         |         |          |                                   |
| Total storage loss                           | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000 (56)                       |
| If cylinder contains dedicated solar storage | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000 (57)                       |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Combi loss                                                      | 40.7887  | 35.5017  | 37.8223  | 35.1668  | 34.8558  | 32.2960  | 33.3726  | 34.8558  | 35.1668  | 37.8223  | 38.0376  | 40.7887 (61)  |
| Total heat required for water heating calculated for each month | 159.4892 | 139.3180 | 144.9513 | 128.5645 | 124.4731 | 109.6290 | 105.0329 | 117.0871 | 118.3802 | 134.7994 | 143.8957 | 155.7438 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 159.4892 | 139.3180 | 144.9513 | 128.5645 | 124.4731 | 109.6290 | 105.0329 | 117.0871 | 118.3802 | 134.7994 | 143.8957 | 155.7438 (64) |
| Heat gains from water heating, kWh/month                        | 49.6651  | 43.3943  | 45.0760  | 39.8464  | 38.5117  | 33.7872  | 32.1702  | 36.0559  | 36.4601  | 41.7005  | 44.7072  | 48.4198 (65)  |

#### 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                                                                               | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.2397  | 11.7594  | 9.5634   | 7.2401   | 5.4121   | 4.5691   | 4.9371   | 6.4174   | 8.6134   | 10.9367  | 12.7647  | 13.6077 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 141.3672 | 142.8341 | 139.1374 | 131.2677 | 121.3335 | 111.9968 | 105.7593 | 104.2924 | 107.9890 | 115.8588 | 125.7930 | 135.1297 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 (71) |
| Water heating gains (Table 5)                                                       | 66.7542  | 64.5749  | 60.5860  | 55.3423  | 51.7631  | 46.9267  | 43.2395  | 48.4622  | 50.6391  | 56.0490  | 62.0934  | 65.0803 (72)  |
| Total internal gains                                                                | 271.7184 | 269.5257 | 259.6442 | 244.2074 | 228.8660 | 213.8499 | 204.2932 | 209.5293 | 217.5989 | 233.2018 | 251.0084 | 264.1750 (73) |

#### 6. Solar gains

| [Jan] | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| North | 3.0900     | 10.6334                        | 0.6300                            | 0.7000                             | 0.7700                       | 10.0416 (74) |
| West  | 4.2900     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 25.7500 (80) |

|             |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Solar gains | 35.7915  | 69.5623  | 115.5646 | 173.3641 | 218.8309 | 227.3181 | 215.0253 | 180.0765 | 135.6873 | 82.6142  | 44.4947  | 29.5467 (83)  |
| Total gains | 307.5099 | 339.0881 | 375.2087 | 417.5715 | 447.6969 | 441.1680 | 419.3186 | 389.6058 | 353.2862 | 315.8161 | 295.5031 | 293.7217 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 70.3354 | 70.5660 | 70.7934 | 71.8817 | 72.0890 | 73.0702 | 73.0702 | 73.2548 | 72.6891                   | 72.0890 | 71.6708 | 71.2388      |
| alpha                                                                       | 5.6890  | 5.7044  | 5.7196  | 5.7921  | 5.8059  | 5.8713  | 5.8713  | 5.8837  | 5.8459                    | 5.8059  | 5.7781  | 5.7493       |
| util living area                                                            | 0.9971  | 0.9943  | 0.9847  | 0.9455  | 0.8329  | 0.6377  | 0.4729  | 0.5280  | 0.8003                    | 0.9676  | 0.9939  | 0.9978 (86)  |
| MIT                                                                         | 20.0258 | 20.1495 | 20.3716 | 20.6677 | 20.8884 | 20.9816 | 20.9972 | 20.9950 | 20.9348                   | 20.6483 | 20.2895 | 20.0068 (87) |
| Th 2                                                                        | 20.0939 | 20.0966 | 20.0992 | 20.1117 | 20.1140 | 20.1249 | 20.1249 | 20.1269 | 20.1207                   | 20.1140 | 20.1093 | 20.1044 (88) |
| util rest of house                                                          | 0.9962  | 0.9924  | 0.9795  | 0.9271  | 0.7844  | 0.5591  | 0.3806  | 0.4311  | 0.7290                    | 0.9530  | 0.9916  | 0.9970 (89)  |
| MIT 2                                                                       | 18.7930 | 18.9752 | 19.2985 | 19.7243 | 20.0073 | 20.1129 | 20.1239 | 20.1248 | 20.0697                   | 19.7067 | 19.1893 | 18.7731 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.5283 (91)  |
| MIT                                                                         | 19.4443 | 19.5956 | 19.8654 | 20.2227 | 20.4727 | 20.5718 | 20.5853 | 20.5845 | 20.5267                   | 20.2041 | 19.7705 | 19.4248 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.4443 | 19.5956 | 19.8654 | 20.2227 | 20.4727 | 20.5718 | 20.5853 | 20.5845 | 20.5267                   | 20.2041 | 19.7705 | 19.4248 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 0.9953   | 0.9911   | 0.9778   | 0.9297   | 0.8053   | 0.6001   | 0.4294   | 0.4825   | 0.7639   | 0.9547       | 0.9904   | 0.9963 (94)    |
| Ext temp.            | 306.0510 | 336.0743 | 366.8912 | 388.2359 | 360.5084 | 264.7574 | 180.0763 | 187.9714 | 269.8867 | 301.5213     | 292.6741 | 292.6304 (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Month fracti         | 713.8283 | 690.4174 | 625.9068 | 522.2160 | 403.4469 | 270.9481 | 180.8153 | 189.3772 | 293.1171 | 441.6793     | 586.1001 | 708.5258 (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating        | 303.3863 | 238.1186 | 192.7076 | 96.4657  | 31.9462  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 104.2776     | 211.2668 | 309.4262 (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 1487.5948 (98) |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 31.1603 (99)   |

#### 8c. Space cooling requirement

Not applicable

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

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |          |           |        |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (201)  |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |          | 1.0000    | (202)  |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |          | 93.4000   | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (208)  |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |          | 1592.7140 | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |           |        |
| Space heating requirement                                             | 303.3863 | 238.1186 | 192.7076 | 96.4657  | 31.9462  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 104.2776 | 211.2668 | 309.4262 | (98)      |        |
| Space heating efficiency (main heating system 1)                      | 93.4000  | 93.4000  | 93.4000  | 93.4000  | 93.4000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.4000  | 93.4000  | 93.4000  | (210)     |        |
| Space heating fuel (main heating system)                              | 324.8247 | 254.9450 | 206.3250 | 103.2823 | 34.2036  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 111.6462 | 226.1957 | 331.2914 | (211)     |        |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (215)     |        |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Water heating requirement                                             | 159.4892 | 139.3180 | 144.9513 | 128.5645 | 124.4731 | 109.6290 | 105.0329 | 117.0871 | 118.3802 | 134.7994 | 143.8957 | 155.7438 | (64)      |        |
| Efficiency of water heater                                            | 86.6449  | 86.3892  | 85.7689  | 84.3394  | 82.1751  | 80.3000  | 80.3000  | 80.3000  | 80.3000  | 84.4136  | 86.0166  | 86.7469  | (216)     |        |
| (217)m                                                                | 86.6449  | 86.3892  | 85.7689  | 84.3394  | 82.1751  | 80.3000  | 80.3000  | 80.3000  | 80.3000  | 84.4136  | 86.0166  | 86.7469  | (217)     |        |
| Fuel for water heating, kWh/month                                     | 184.0722 | 161.2678 | 169.0021 | 152.4371 | 151.4731 | 136.5243 | 130.8006 | 145.8121 | 147.4224 | 159.6893 | 167.2883 | 179.5382 | (219)     |        |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          |          | 1885.3273 | (219)  |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          |          | 1592.7140 | (211)  |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)  |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |          |           |        |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c) |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          |          | 233.8175  | (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          |          | 3786.8587 | (238)  |

#### 12a. Carbon dioxide 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                                                                     | 1592.7140          | 0.2160                        | 344.0262 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1885.3273          | 0.2160                        | 407.2307 (264)           |
| Space and water heating                                                                           |                    |                               | 751.2569 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 233.8175           | 0.5190                        | 121.3513 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 911.5332 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 15.7364 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.5419 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.8154 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (15.7364 * 1.00) + 2.5419 + 0.8154, rounded to 2 d.p. |                    |                               | 19.0900 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)  
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 47.7400 (1b)              | x 2.2700 (2b)                   | = 108.3698 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 47.7400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 108.3698 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total    | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|----------|----------------------------|
| Number of chimneys                                   | 0                            | 0                    | 0     | 0 * 40 = | 0.0000 (6a)                |
| Number of open flues                                 | 0                            | 0                    | 0     | 0 * 20 = | 0.0000 (6b)                |
| Number of intermittent fans                          |                              |                      |       | 2 * 10 = | 20.0000 (7a)               |
| Number of passive vents                              |                              |                      |       | 0 * 10 = | 0.0000 (7b)                |
| Number of flueless gas fires                         |                              |                      |       | 0 * 40 = | 0.0000 (7c)                |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |          | Air changes per hour       |
| Pressure test                                        |                              |                      |       |          | 20.0000 / (5) = 0.1846 (8) |
| Measured/design AP50                                 |                              |                      |       |          | Yes                        |
| Infiltration rate                                    |                              |                      |       |          | 3.2500                     |
| Number of sides sheltered                            |                              |                      |       |          | 0.3471 (18)                |
|                                                      |                              |                      |       |          | 2 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |          | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |          | 0.2950 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3761 | 0.3687 | 0.3614 | 0.3245 | 0.3171 | 0.2802 | 0.2802 | 0.2729 | 0.2950 | 0.3171 | 0.3319 | 0.3466 (22b) |
| Effective ac    | 0.5707 | 0.5680 | 0.5653 | 0.5526 | 0.5503 | 0.5393 | 0.5393 | 0.5372 | 0.5435 | 0.5503 | 0.5551 | 0.5601 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| Windows (Uw = 1.40)                                            |                         |                            | 7.3800                    | 1.3258                        | 9.7841       |                                      | (27)            |
| External Wall                                                  | 34.1800                 | 7.3800                     | 26.8000                   | 0.2000                        | 5.3600       | 9.0000                               | 241.2000 (29a)  |
| Pitched Roof                                                   | 44.7900                 |                            | 44.7900                   | 0.1000                        | 4.4790       | 9.0000                               | 403.1100 (30)   |
| Sloping Roof                                                   | 1.7600                  |                            | 1.7600                    | 0.1600                        | 0.2816       | 9.0000                               | 15.8400 (30)    |
| Dormer Roof                                                    | 0.8100                  |                            | 0.8100                    | 0.1800                        | 0.1458       | 9.0000                               | 7.2900 (30)     |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 81.5400                   |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 20.0505      |                                      | (33)            |
| Party Wall                                                     |                         |                            | 29.7400                   | 0.0000                        | 0.0000       | 20.0000                              | 594.8000 (32)   |
| Party Floor                                                    |                         |                            | 47.7400                   |                               |              | 30.0000                              | 1432.2000 (32d) |
| Internal Walls                                                 |                         |                            | 69.7400                   |                               |              | 9.0000                               | 627.6600 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 3322.1000 (34)  |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 69.5873 (35)    |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 7.4725 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 27.5230 (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                     | 20.4106 | 20.3123 | 20.2161 | 19.7638 | 19.6792 | 19.2853 | 19.2853 | 19.2124 | 19.4371 | 19.6792 | 19.8504 | 20.0293 (38) |
| Heat transfer coeff       | 47.9336 | 47.8353 | 47.7390 | 47.2868 | 47.2022 | 46.8083 | 46.8083 | 46.7354 | 46.9601 | 47.2022 | 47.3734 | 47.5523 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 47.2864 (39) |
| HLP                       | 1.0041  | 1.0020  | 1.0000  | 0.9905  | 0.9887  | 0.9805  | 0.9805  | 0.9790  | 0.9837  | 0.9887  | 0.9923  | 0.9961 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.9905 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |         |         |         |         |         |         |                    |          |                |
|------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                        |          |          |          |         |         |         |         |         |         |                    |          | 1.6238 (42)    |
| Average daily hot water use (litres/day) |          |          |          |         |         |         |         |         |         |                    |          | 72.7658 (43)   |
| Daily hot water use                      | 80.0424  | 77.1317  | 74.2211  | 71.3105 | 68.3998 | 65.4892 | 65.4892 | 68.3998 | 71.3105 | 74.2211            | 77.1317  | 80.0424 (44)   |
| Energy conte                             | 118.7005 | 103.8162 | 107.1290 | 93.3977 | 89.6173 | 77.3329 | 71.6603 | 82.2313 | 83.2134 | 96.9772            | 105.8582 | 114.9551 (45)  |
| Energy content (annual)                  |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1144.8892 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000             | 0.0000   | 0.0000 (46)    |
| Water storage loss:                      |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                              |         |         |         |         |         |         |         |         |         |         |         |              |
|----------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Total storage loss                           | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (56)  |
| If cylinder contains dedicated solar storage | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (57)  |
| Primary loss                                 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (59)  |
| Heat gains from water heating, kWh/month     | 25.2239 | 22.0609 | 22.7649 | 19.8470 | 19.0437 | 16.4332 | 15.2278 | 17.4741 | 17.6828 | 20.6076 | 22.4949 | 24.4280 (65) |

#### 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                                                                               | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.2397  | 11.7594  | 9.5634   | 7.2401   | 5.4121   | 4.5691   | 4.9371   | 6.4174   | 8.6134   | 10.9367  | 12.7647  | 13.6077  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 141.3672 | 142.8341 | 139.1374 | 131.2677 | 121.3335 | 111.9968 | 105.7593 | 104.2924 | 107.9890 | 115.8588 | 125.7930 | 135.1297 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | (69) |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | (71) |
| Water heating gains (Table 5)                                                       | 33.9030  | 32.8288  | 30.5980  | 27.5653  | 25.5963  | 22.8240  | 20.4675  | 23.4868  | 24.5595  | 27.6985  | 31.2429  | 32.8333  | (72) |
| Total internal gains                                                                | 235.8672 | 234.7796 | 226.6562 | 213.4304 | 199.6993 | 186.7472 | 178.5212 | 181.5538 | 188.5193 | 201.8513 | 217.1579 | 228.9280 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|---------------|
| North       |          |          |          |          | 3.0900     | 10.6334                        | 0.6300                            | 0.7000                             | 0.7700                       | 10.0416      |          |               |
| West        |          |          |          |          | 4.2900     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 25.7500 (80) |          |               |
|             |          |          |          |          |            |                                |                                   |                                    |                              |              |          |               |
| Solar gains | 35.7915  | 69.5623  | 115.5646 | 173.3641 | 218.8309   | 227.3181                       | 215.0253                          | 180.0765                           | 135.6873                     | 82.6142      | 44.4947  | 29.5467 (83)  |
| Total gains | 271.6588 | 304.3420 | 342.2208 | 386.7945 | 418.5302   | 414.0653                       | 393.5465                          | 361.6304                           | 324.2066                     | 284.4655     | 261.6526 | 258.4746 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 19.2518 | 19.2913 | 19.3302 | 19.5151 | 19.5500 | 19.7146 | 19.7146 | 19.7453 | 19.6509                   | 19.5500 | 19.4794 | 19.4061 |              |
| alpha                                                                       | 2.2835  | 2.2861  | 2.2887  | 2.3010  | 2.3033  | 2.3143  | 2.3143  | 2.3164  | 2.3101                    | 2.3033  | 2.2986  | 2.2937  |              |
| util living area                                                            | 0.9423  | 0.9240  | 0.8881  | 0.8186  | 0.7137  | 0.5797  | 0.4602  | 0.5065  | 0.6977                    | 0.8567  | 0.9242  | 0.9479  | (86)         |
| MIT                                                                         | 18.3415 | 18.6106 | 19.1008 | 19.7446 | 20.3104 | 20.7062 | 20.8774 | 20.8429 | 20.5179                   | 19.7846 | 18.9547 | 18.2860 | (87)         |
| Th 2                                                                        | 20.0800 | 20.0817 | 20.0833 | 20.0913 | 20.0927 | 20.0996 | 20.0996 | 20.1009 | 20.0970                   | 20.0927 | 20.0897 | 20.0866 | (88)         |
| util rest of house                                                          | 0.9359  | 0.9156  | 0.8754  | 0.7971  | 0.6779  | 0.5230  | 0.3824  | 0.4288  | 0.6474                    | 0.8350  | 0.9144  | 0.9421  | (89)         |
| MIT 2                                                                       | 17.6283 | 17.8945 | 18.3769 | 19.0061 | 19.5400 | 19.8979 | 20.0340 | 20.0125 | 19.7436                   | 19.0576 | 18.2436 | 17.5781 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.5283  | (91)         |
| MIT                                                                         | 18.0051 | 18.2728 | 18.7593 | 19.3963 | 19.9470 | 20.3249 | 20.4795 | 20.4512 | 20.1526                   | 19.4417 | 18.6193 | 17.9521 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 18.0051 | 18.2728 | 18.7593 | 19.3963 | 19.9470 | 20.3249 | 20.4795 | 20.4512 | 20.1526                   | 19.4417 | 18.6193 | 17.9521 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec       |       |
| Useful gains         | 0.9174   | 0.8949   | 0.8533   | 0.7783   | 0.6716   | 0.5379   | 0.4165   | 0.4605   | 0.6508   | 0.8166       | 0.8946   | 0.9245    | (94)  |
| Ext temp.            | 249.2113 | 272.3573 | 292.0027 | 301.0566 | 281.1020 | 222.7424 | 163.9014 | 166.5169 | 210.9979 | 232.2999     | 234.0716 | 238.9651  | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 656.9347 | 639.6904 | 585.2464 | 496.3354 | 389.2752 | 267.9741 | 181.5946 | 189.3350 | 284.2324 | 417.3464     | 545.7077 | 653.9420  | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000    | (97a) |
| Space heating per m2 | 303.3462 | 246.8479 | 218.1733 | 140.6008 | 80.4808  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 137.6746     | 224.3780 | 308.7428  | (98)  |
|                      |          |          |          |          |          |          |          |          |          |              |          | 1660.2444 | (98)  |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 34.7768   | (99)  |

#### 8c. Space cooling requirement

|                                                     |        |        |        |        |         |          |          |          |         |         |        |        |        |
|-----------------------------------------------------|--------|--------|--------|--------|---------|----------|----------|----------|---------|---------|--------|--------|--------|
| Calculated for June, July and August. See Table 10b | Jan    | Feb    | Mar    | Apr    | May     | Jun      | Jul      | Aug      | Sep     | Oct     | Nov    | Dec    |        |
| Ext. temp.                                          | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000  | 16.6000  | 16.4000  | 14.1000 | 10.6000 | 7.1000 | 4.2000 |        |
| Heat loss rate W                                    | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 439.9984 | 346.3817 | 355.1890 | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (100)  |
| Utilisation                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.7694   | 0.8242   | 0.7978   | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (101)  |
| Useful loss                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 338.5456 | 285.4830 | 283.3523 | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (102)  |
| Total gains                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 545.9458 | 520.8314 | 484.5127 | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (103)  |
| Month fracti                                        | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1.0000   | 1.0000   | 1.0000   | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (103a) |
| Space cooling kWh                                   |        |        |        |        |         |          |          |          |         |         |        |        |        |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                          |        |        |        |        |        |          |          |          |                          |        |        |                |
|------------------------------------------|--------|--------|--------|--------|--------|----------|----------|----------|--------------------------|--------|--------|----------------|
|                                          | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 149.3282 | 175.0992 | 149.6634 | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (104)   |
| Space cooling                            |        |        |        |        |        |          |          |          |                          |        |        | 474.0907 (104) |
| Cooled fraction                          |        |        |        |        |        |          |          |          | FC = cooled area / (4) = |        |        | 1.0000 (105)   |
| Intermittency factor (Table 10b)         |        |        |        |        |        |          |          |          |                          |        |        |                |
|                                          | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.2500   | 0.2500   | 0.2500   | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (106)   |
| Space cooling kWh                        |        |        |        |        |        |          |          |          |                          |        |        |                |
|                                          | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 37.3320  | 43.7748  | 37.4158  | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (107)   |
| Space cooling                            |        |        |        |        |        |          |          |          |                          |        |        | 118.5227 (107) |
| Space cooling per m2                     |        |        |        |        |        |          |          |          |                          |        |        | 2.4827 (108)   |
| Energy for space heating                 |        |        |        |        |        |          |          |          |                          |        |        | 34.7768 (99)   |
| Energy for space cooling                 |        |        |        |        |        |          |          |          |                          |        |        | 2.4827 (108)   |
| Total                                    |        |        |        |        |        |          |          |          |                          |        |        | 37.2595 (109)  |
| Dwelling Fabric Energy Efficiency (DFEE) |        |        |        |        |        |          |          |          |                          |        |        | 37.3 (109)     |

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)  
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 47.7400 (1b)              | x 2.2700 (2b)                   | = 108.3698 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 47.7400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 108.3698 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total    | m3 per hour                             |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|----------|-----------------------------------------|
| Number of chimneys                                                        | 0               | 0                    | 0     | 0 * 40 = | 0.0000 (6a)                             |
| Number of open flues                                                      | 0               | 0                    | 0     | 0 * 20 = | 0.0000 (6b)                             |
| Number of intermittent fans                                               |                 |                      |       | 2 * 10 = | 20.0000 (7a)                            |
| Number of passive vents                                                   |                 |                      |       | 0 * 10 = | 0.0000 (7b)                             |
| Number of flueless gas fires                                              |                 |                      |       | 0 * 40 = | 0.0000 (7c)                             |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |          | 20.0000 / (5) = 0.1846 (8)              |
| Pressure test                                                             |                 |                      |       |          | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |          | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |          | 0.4346 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |          | 2 (19)                                  |
| Shelter factor                                                            |                 |                      |       |          | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |          | (21) = (18) x (20) = 0.3694 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.4709 | 0.4617 | 0.4525 | 0.4063 | 0.3971 | 0.3509 | 0.3509 | 0.3417 | 0.3694 | 0.3971 | 0.4155 | 0.4340 (22b) |
| Effective ac    | 0.6109 | 0.6066 | 0.6024 | 0.5825 | 0.5788 | 0.5616 | 0.5616 | 0.5584 | 0.5682 | 0.5788 | 0.5863 | 0.5942 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                 | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|------------------------------|--------------------------------|----------------------------|
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 7.3800                    | 1.3258                        | 9.7841                       |                                | (27)                       |
| External Wall                                                  | 34.1800                 | 7.3800                     | 26.8000                   | 0.1800                        | 4.8240                       |                                | (29a)                      |
| Pitched Roof                                                   | 44.7900                 |                            | 44.7900                   | 0.1300                        | 5.8227                       |                                | (30)                       |
| Sloping Roof                                                   | 1.7600                  |                            | 1.7600                    | 0.1300                        | 0.2288                       |                                | (30)                       |
| Dormer Roof                                                    | 0.8100                  |                            | 0.8100                    | 0.1300                        | 0.1053                       |                                | (30)                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 81.5400                   |                               |                              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           |                               | (26)...(30) + (32) = 20.7649 |                                | (33)                       |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                              |                                | 250.0000 (35)              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |                              |                                | 4.5235 (36)                |
| Total fabric heat loss                                         |                         |                            |                           |                               |                              |                                | (33) + (36) = 25.2884 (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                     | 21.8469 | 21.6929 | 21.5419 | 20.8329 | 20.7003 | 20.0827 | 20.0827 | 19.9684 | 20.3206 | 20.7003 | 20.9686 | 21.2492 (38) |
| Heat transfer coeff       | 47.1353 | 46.9813 | 46.8303 | 46.1213 | 45.9887 | 45.3711 | 45.3711 | 45.2568 | 45.6090 | 45.9887 | 46.2570 | 46.5376 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 46.1207 (39) |
| HLP                       | 0.9873  | 0.9841  | 0.9809  | 0.9661  | 0.9633  | 0.9504  | 0.9504  | 0.9480  | 0.9554  | 0.9633  | 0.9689  | 0.9748 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.9661 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                              |          |          |          |         |         |         |         |         |         |         |          |                                   |
|----------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|---------|----------|-----------------------------------|
| Assumed occupancy                            |          |          |          |         |         |         |         |         |         |         |          | 1.6238 (42)                       |
| Average daily hot water use (litres/day)     |          |          |          |         |         |         |         |         |         |         |          | 72.7658 (43)                      |
| Daily hot water use                          | 80.0424  | 77.1317  | 74.2211  | 71.3105 | 68.3998 | 65.4892 | 65.4892 | 68.3998 | 71.3105 | 74.2211 | 77.1317  | 80.0424 (44)                      |
| Energy conte                                 | 118.7005 | 103.8162 | 107.1290 | 93.3977 | 89.6173 | 77.3329 | 71.6603 | 82.2313 | 83.2134 | 96.9772 | 105.8582 | 114.9551 (45)                     |
| Energy content (annual)                      |          |          |          |         |         |         |         |         |         |         |          | Total = Sum(45)m = 1144.8892 (45) |
| Distribution loss (46)m = 0.15 x (45)m       | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000 (46)                       |
| Water storage loss:                          |          |          |          |         |         |         |         |         |         |         |          |                                   |
| Total storage loss                           | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000 (56)                       |
| If cylinder contains dedicated solar storage | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000 (57)                       |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Primary loss                             | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (59)  |
| Heat gains from water heating, kWh/month | 25.2239 | 22.0609 | 22.7649 | 19.8470 | 19.0437 | 16.4332 | 15.2278 | 17.4741 | 17.6828 | 20.6076 | 22.4949 | 24.4280 (65) |

#### 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                                                                               | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | 81.1911  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.2397  | 11.7594  | 9.5634   | 7.2401   | 5.4121   | 4.5691   | 4.9371   | 6.4174   | 8.6134   | 10.9367  | 12.7647  | 13.6077  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 141.3672 | 142.8341 | 139.1374 | 131.2677 | 121.3335 | 111.9968 | 105.7593 | 104.2924 | 107.9890 | 115.8588 | 125.7930 | 135.1297 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | 31.1191  | (69) |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | (71) |
| Water heating gains (Table 5)                                                       | 33.9030  | 32.8288  | 30.5980  | 27.5653  | 25.5963  | 22.8240  | 20.4675  | 23.4868  | 24.5595  | 27.6985  | 31.2429  | 32.8333  | (72) |
| Total internal gains                                                                | 235.8672 | 234.7796 | 226.6562 | 213.4304 | 199.6993 | 186.7472 | 178.5212 | 181.5538 | 188.5193 | 201.8513 | 217.1579 | 228.9280 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|
| North       |          |          |          |          | 3.0900     | 10.6334                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 10.0416       |
| West        |          |          |          |          | 4.2900     | 19.6403                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 25.7500 (80)  |
| -----       |          |          |          |          |            |                                |                                   |                                    |          |          |                              |               |
| Solar gains | 35.7915  | 69.5623  | 115.5646 | 173.3641 | 218.8309   | 227.3181                       | 215.0253                          | 180.0765                           | 135.6873 | 82.6142  | 44.4947                      | 29.5467 (83)  |
| Total gains | 271.6588 | 304.3420 | 342.2208 | 386.7945 | 418.5302   | 414.0653                       | 393.5465                          | 361.6304                           | 324.2066 | 284.4655 | 261.6526                     | 258.4746 (84) |

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

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

|                                                                    |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|--------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
|                                                                    | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                | 70.3354 | 70.5660 | 70.7934 | 71.8817 | 72.0890 | 73.0702 | 73.0702 | 73.2548 | 72.6891                   | 72.0890 | 71.6708 | 71.2388 |              |
| alpha                                                              | 5.6890  | 5.7044  | 5.7196  | 5.7921  | 5.8059  | 5.8713  | 5.8713  | 5.8837  | 5.8459                    | 5.8059  | 5.7781  | 5.7493  |              |
| util living area                                                   | 0.9985  | 0.9967  | 0.9901  | 0.9600  | 0.8621  | 0.6727  | 0.5026  | 0.5660  | 0.8409                    | 0.9796  | 0.9967  | 0.9988  | (86)         |
| MIT                                                                | 19.9541 | 20.0809 | 20.3094 | 20.6199 | 20.8638 | 20.9758 | 20.9962 | 20.9928 | 20.9142                   | 20.5935 | 20.2225 | 19.9359 | (87)         |
| Th 2                                                               | 20.0939 | 20.0966 | 20.0992 | 20.1117 | 20.1140 | 20.1249 | 20.1249 | 20.1269 | 20.1207                   | 20.1140 | 20.1093 | 20.1044 | (88)         |
| util rest of house                                                 | 0.9979  | 0.9956  | 0.9865  | 0.9455  | 0.8176  | 0.5924  | 0.4052  | 0.4636  | 0.7747                    | 0.9697  | 0.9954  | 0.9985  | (89)         |
| MIT 2                                                              | 19.1343 | 19.2629 | 19.4919 | 19.8036 | 20.0229 | 20.1139 | 20.1239 | 20.1248 | 20.0729                   | 19.7847 | 19.4149 | 19.1248 | (90)         |
| Living area fraction                                               |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         |         | 0.5283 (91)  |
| MIT                                                                | 19.5674 | 19.6951 | 19.9238 | 20.2348 | 20.4671 | 20.5693 | 20.5847 | 20.5834 | 20.5173                   | 20.2120 | 19.8416 | 19.5533 | (92)         |
| Temperature adjustment                                             |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                       | 19.5674 | 19.6951 | 19.9238 | 20.2348 | 20.4671 | 20.5693 | 20.5847 | 20.5834 | 20.5173                   | 20.2120 | 19.8416 | 19.5533 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|-----------|-------|
| Utilisation          | 0.9976   | 0.9949   | 0.9857   | 0.9478   | 0.8367   | 0.6343   | 0.4568   | 0.5179   | 0.8069   | 0.9710       | 0.9949   | 0.9982    | (94)  |
| Useful gains         | 270.9953 | 302.7972 | 337.3257 | 366.6143 | 350.1742 | 262.6413 | 179.7718 | 187.3000 | 261.6072 | 276.2091     | 260.3134 | 257.9970  | (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000    | (96)  |
| Heat loss rate W     | 719.6310 | 695.9010 | 628.6391 | 522.7761 | 403.1890 | 270.8323 | 180.7920 | 189.3262 | 292.6886 | 442.0408     | 589.3865 | 714.5035  | (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000    | (97a) |
| Space heating kWh    | 333.7850 | 263.6215 | 216.7372 | 112.4365 | 39.4430  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 123.3787     | 236.9326 | 339.6408  | (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1665.9753 | (98)  |
| Alpha heating per m2 |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 34.8968   | (99)  |

#### 8c. Space cooling requirement

##### Calculated for June, July and August. See Table 10b

|                                  |        |        |        |        |         |          |          |          |         |         |        |          |        |
|----------------------------------|--------|--------|--------|--------|---------|----------|----------|----------|---------|---------|--------|----------|--------|
| Ext. temp.                       | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000  | 16.6000  | 16.4000  | 14.1000 | 10.6000 | 7.1000 | 4.2000   |        |
| Heat loss rate W                 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 426.4887 | 335.7464 | 343.9515 | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (100)  |
| Utilisation                      | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.9371   | 0.9716   | 0.9573   | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (101)  |
| Useful loss                      | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 399.6822 | 326.2207 | 329.2738 | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (102)  |
| Total gains                      | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 545.9458 | 520.8314 | 484.5127 | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (103)  |
| Month fracti                     | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1.0000   | 1.0000   | 1.0000   | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (103a) |
| Space cooling kWh                | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 105.3098 | 144.7904 | 115.4977 | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (104)  |
| Space cooling                    |        |        |        |        |         |          |          |          |         |         |        | 365.5979 | (104)  |
| Cooled fraction                  |        |        |        |        |         |          |          |          |         |         |        | 1.0000   | (105)  |
| Intermittency factor (Table 10b) |        |        |        |        |         |          |          |          |         |         |        |          |        |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                        |        |        |        |        |        |         |         |         |        |        |        |               |
|----------------------------------------|--------|--------|--------|--------|--------|---------|---------|---------|--------|--------|--------|---------------|
| Space cooling kWh                      | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.2500  | 0.2500  | 0.2500  | 0.0000 | 0.0000 | 0.0000 | 0.0000 (106)  |
| Space cooling                          | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 26.3274 | 36.1976 | 28.8744 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (107)  |
| Space cooling per m2                   |        |        |        |        |        |         |         |         |        |        |        | 91.3995 (107) |
| Energy for space heating               |        |        |        |        |        |         |         |         |        |        |        | 1.9145 (108)  |
| Energy for space cooling               |        |        |        |        |        |         |         |         |        |        |        | 34.8968 (99)  |
| Total                                  |        |        |        |        |        |         |         |         |        |        |        | 1.9145 (108)  |
| Target Fabric Energy Efficiency (TFEE) |        |        |        |        |        |         |         |         |        |        |        | 36.8114 (109) |
|                                        |        |        |        |        |        |         |         |         |        |        |        | 42.3 (109)    |

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)  
CALCULATION OF HEAT DEMAND 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 47.7400 (1b)              | x 2.2700 (2b)                   | = 108.3698 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 47.7400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 108.3698 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1846 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 3.2500                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3471 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 2 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.2950 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 4.4000 | 4.1000 | 4.1000 | 3.9000 | 3.9000 | 3.7000 | 3.7000 | 3.5000 | 3.5000 | 3.8000 | 3.7000 | 3.9000 (22)  |
| Wind factor     | 1.1000 | 1.0250 | 1.0250 | 0.9750 | 0.9750 | 0.9250 | 0.9250 | 0.8750 | 0.8750 | 0.9500 | 0.9250 | 0.9750 (22a) |
| Adj infilt rate | 0.3245 | 0.3024 | 0.3024 | 0.2876 | 0.2876 | 0.2729 | 0.2729 | 0.2581 | 0.2581 | 0.2802 | 0.2729 | 0.2876 (22b) |
| Effective ac    | 0.5526 | 0.5457 | 0.5457 | 0.5414 | 0.5414 | 0.5372 | 0.5372 | 0.5333 | 0.5333 | 0.5393 | 0.5372 | 0.5414 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                       |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------------------------------------------|
| Windows (Uw = 1.40)                                            |                         |                            | 7.3800                    | 1.3258                        | 9.7841       |                                | (27)                                                |
| External Wall                                                  | 34.1800                 | 7.3800                     | 26.8000                   | 0.2000                        | 5.3600       | 9.0000                         | 241.2000 (29a)                                      |
| Pitched Roof                                                   | 44.7900                 |                            | 44.7900                   | 0.1000                        | 4.4790       | 9.0000                         | 403.1100 (30)                                       |
| Sloping Roof                                                   | 1.7600                  |                            | 1.7600                    | 0.1600                        | 0.2816       | 9.0000                         | 15.8400 (30)                                        |
| Dormer Roof                                                    | 0.8100                  |                            | 0.8100                    | 0.1800                        | 0.1458       | 9.0000                         | 7.2900 (30)                                         |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 81.5400                   |                               |              |                                | (31)                                                |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 20.0505      |                                | (33)                                                |
| Party Wall                                                     |                         |                            | 29.7400                   | 0.0000                        | 0.0000       | 20.0000                        | 594.8000 (32)                                       |
| Party Floor                                                    |                         |                            | 47.7400                   |                               |              | 30.0000                        | 1432.2000 (32d)                                     |
| Internal Walls                                                 |                         |                            | 69.7400                   |                               |              | 9.0000                         | 627.6600 (32c)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 3322.1000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 69.5873 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 7.4725 (36)                                         |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 27.5230 (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                     | 19.7638 | 19.5158 | 19.5158 | 19.3602 | 19.3602 | 19.2124 | 19.2124 | 19.0724 | 19.0724 | 19.2853 | 19.2124 | 19.3602 (38) |
| Heat transfer coeff       | 47.2868 | 47.0388 | 47.0388 | 46.8832 | 46.8832 | 46.7354 | 46.7354 | 46.5954 | 46.5954 | 46.8083 | 46.7354 | 46.8832 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 46.8516 (39) |
| HLP                       | 0.9905  | 0.9853  | 0.9853  | 0.9821  | 0.9821  | 0.9790  | 0.9790  | 0.9760  | 0.9760  | 0.9805  | 0.9790  | 0.9821 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.9814 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |         |         |         |         |         |         |                    |          |                |
|------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                        |          |          |          |         |         |         |         |         |         |                    |          | 1.6238 (42)    |
| Average daily hot water use (litres/day) |          |          |          |         |         |         |         |         |         |                    |          | 72.7658 (43)   |
| Daily hot water use                      | 80.0424  | 77.1317  | 74.2211  | 71.3105 | 68.3998 | 65.4892 | 65.4892 | 68.3998 | 71.3105 | 74.2211            | 77.1317  | 80.0424 (44)   |
| Energy conte                             | 118.7005 | 103.8162 | 107.1290 | 93.3977 | 89.6173 | 77.3329 | 71.6603 | 82.2313 | 83.2134 | 96.9772            | 105.8582 | 114.9551 (45)  |
| Energy content (annual)                  |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1144.8892 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |         |         |         |         |         |         |                    |          |                |
|                                          | 17.8051  | 15.5724  | 16.0694  | 14.0097 | 13.4426 | 11.5999 | 10.7490 | 12.3347 | 12.4820 | 14.5466            | 15.8787  | 17.2433 (46)   |
| Water storage loss:                      |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF HEAT DEMAND 09 Jan 2014

|                                                                 |          |          |          |          |          |         |         |         |         |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|----------------|
| Total storage loss                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000 (56)    |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000 (57)    |
| Combi loss                                                      | 13.9846  | 12.6175  | 13.9474  | 13.4726  | 13.9037  | 13.4343 | 13.8692 | 13.8916 | 13.4552 | 13.9293  | 13.5088  | 13.9774 (61)   |
| Total heat required for water heating calculated for each month | 132.6851 | 116.4337 | 121.0764 | 106.8703 | 103.5210 | 90.7673 | 85.5295 | 96.1228 | 96.6686 | 110.9065 | 119.3669 | 128.9325 (62)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 | 132.6851 | 116.4337 | 121.0764 | 106.8703 | 103.5210 | 90.7673 | 85.5295 | 96.1228 | 96.6686 | 110.9065 | 119.3669 | 128.9325 (64)  |
| RHI water heating demand                                        | 42.9641  | 37.6733  | 39.1073  | 34.4229  | 33.2737  | 29.0718 | 27.2944 | 30.8148 | 31.0323 | 35.7272  | 38.5750  | 41.7169 (65)   |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |         |         |         |         |          |          | 1308.8807 (64) |
|                                                                 |          |          |          |          |          |         |         |         |         |          |          | 1309 (64)      |

#### 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                                                                               | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 33.0993  | 29.3985  | 23.9085  | 18.1002  | 13.5301  | 11.4227  | 12.3426  | 16.0434  | 21.5335  | 27.3417  | 31.9118  | 34.0192  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 210.9958 | 213.1852 | 207.6678 | 195.9219 | 181.0948 | 167.1594 | 157.8497 | 155.6603 | 161.1777 | 172.9236 | 187.7507 | 201.6861 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | (71) |
| Water heating gains (Table 5)                                                       | 57.7474  | 56.0614  | 52.5635  | 47.8096  | 44.7227  | 40.3775  | 36.6860  | 41.4177  | 43.1003  | 48.0205  | 53.5764  | 56.0711  | (72) |
| Total internal gains                                                                | 383.6857 | 380.4883 | 365.9830 | 343.6749 | 321.1909 | 300.8028 | 288.7216 | 294.9646 | 307.6547 | 330.1290 | 355.0821 | 373.6196 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|
| North       |          |          |          |          | 3.0900     | 13.4839                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 12.7334 (74)  |
| West        |          |          |          |          | 4.2900     | 25.1925                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 33.0294 (80)  |
| -----       |          |          |          |          |            |                                |                                   |                                    |          |          |                              |               |
| Solar gains | 45.7629  | 75.9132  | 127.3579 | 192.0130 | 228.6638   | 260.0782                       | 237.4916                          | 208.0071                           | 156.7462 | 96.1340  | 56.7588                      | 35.7254 (83)  |
| Total gains | 429.4485 | 456.4016 | 493.3409 | 535.6879 | 549.8547   | 560.8811                       | 526.2132                          | 502.9717                           | 464.4009 | 426.2630 | 411.8409                     | 409.3451 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 19.5151 | 19.6180 | 19.6180 | 19.6831 | 19.6831 | 19.7453 | 19.7453 | 19.8047 | 19.8047 | 19.7146 | 19.7453 | 19.6831 |              |
| alpha                                                                       | 2.3010  | 2.3079  | 2.3079  | 2.3122  | 2.3122  | 2.3164  | 2.3164  | 2.3203  | 2.3203  | 2.3143  | 2.3164  | 2.3122  |              |
| util living area                                                            | 0.8554  | 0.8324  | 0.7777  | 0.6847  | 0.5528  | 0.3892  | 0.2808  | 0.2919  | 0.4925  | 0.6942  | 0.8109  | 0.8638  | (86)         |
| MIT                                                                         | 19.1809 | 19.3732 | 19.7855 | 20.2656 | 20.6724 | 20.9010 | 20.9681 | 20.9656 | 20.8177 | 20.3812 | 19.7412 | 19.1601 | (87)         |
| Th 2                                                                        | 20.0913 | 20.0956 | 20.0956 | 20.0983 | 20.0983 | 20.1009 | 20.1009 | 20.1034 | 20.1034 | 20.0996 | 20.1009 | 20.0983 | (88)         |
| util rest of house                                                          | 0.8413  | 0.8163  | 0.7561  | 0.6539  | 0.5077  | 0.3294  | 0.2085  | 0.2173  | 0.4316  | 0.6564  | 0.7900  | 0.8503  | (89)         |
| MIT 2                                                                       | 18.4534 | 18.6421 | 19.0381 | 19.4911 | 19.8569 | 20.0438 | 20.0887 | 20.0901 | 19.9877 | 19.6095 | 19.0070 | 18.4395 | (90)         |
| Living area fraction                                                        | 18.8377 | 19.0283 | 19.4329 | 19.9002 | 20.2877 | 20.4966 | 20.5532 | 20.5526 | 20.4262 | 20.0172 | 19.3949 | 18.8202 | (91)         |
| MIT                                                                         | 18.8377 | 19.0283 | 19.4329 | 19.9002 | 20.2877 | 20.4966 | 20.5532 | 20.5526 | 20.4262 | 20.0172 | 19.3949 | 18.8202 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 18.8377 | 19.0283 | 19.4329 | 19.9002 | 20.2877 | 20.4966 | 20.5532 | 20.5526 | 20.4262 | 20.0172 | 19.3949 | 18.8202 | (93)         |

#### 8. Space heating requirement

|                          |          |          |          |          |          |          |          |          |          |          |          |           |       |
|--------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation              | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains             | 0.8187   | 0.7946   | 0.7386   | 0.6467   | 0.5175   | 0.3563   | 0.2455   | 0.2553   | 0.4543   | 0.6527   | 0.7713   | 0.8277    | (94)  |
| Ext temp.                | 351.5698 | 362.6528 | 364.3629 | 346.4269 | 284.5750 | 199.8501 | 129.1626 | 128.4037 | 210.9913 | 278.2210 | 317.6643 | 338.8328  | (95)  |
| Heat loss rate W         | 5.4000   | 5.9000   | 7.6000   | 10.0000  | 13.1000  | 15.9000  | 17.7000  | 17.7000  | 15.3000  | 12.0000  | 8.4000   | 5.5000    | (96)  |
| Month fracti             | 635.4271 | 617.5410 | 556.6078 | 464.1555 | 336.9828 | 214.8237 | 133.3477 | 132.9172 | 238.8566 | 375.2714 | 513.8497 | 624.4943  | (97)  |
| Space heating kWh        | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating            | 211.1898 | 171.2849 | 143.0302 | 84.7645  | 38.9914  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 72.2055  | 141.2535 | 212.5321  | (98)  |
| RHI space heating demand |          |          |          |          |          |          |          |          |          |          |          | 1075.2520 | (98)  |
|                          |          |          |          |          |          |          |          |          |          |          |          | 1075      | (98)  |

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## Calculation Type: New Build (As Built)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)  
CALCULATION OF ENERGY RATINGS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 47.7400 (1b)              | x 2.2700 (2b)                   | = 108.3698 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 47.7400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 108.3698 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | Air changes per hour       |
| Pressure test                                        |                              |                      |       |       | 20.0000 / (5) = 0.1846 (8) |
| Measured/design AP50                                 |                              |                      |       |       | Yes                        |
| Infiltration rate                                    |                              |                      |       |       | 3.2500                     |
| Number of sides sheltered                            |                              |                      |       |       | 0.3471 (18)                |
|                                                      |                              |                      |       |       | 2 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.2950 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.3761 | 0.3687 | 0.3614 | 0.3245 | 0.3171 | 0.2802 | 0.2802 | 0.2729 | 0.2950 | 0.3171 | 0.3319 | 0.3466 (22b) |
| Effective ac    | 0.5707 | 0.5680 | 0.5653 | 0.5526 | 0.5503 | 0.5393 | 0.5393 | 0.5372 | 0.5435 | 0.5503 | 0.5551 | 0.5601 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| Windows (Uw = 1.40)                                            |                         |                            | 7.3800                    | 1.3258                        | 9.7841       |                                      | (27)            |
| External Wall                                                  | 34.1800                 | 7.3800                     | 26.8000                   | 0.2000                        | 5.3600       | 9.0000                               | 241.2000 (29a)  |
| Pitched Roof                                                   | 44.7900                 |                            | 44.7900                   | 0.1000                        | 4.4790       | 9.0000                               | 403.1100 (30)   |
| Sloping Roof                                                   | 1.7600                  |                            | 1.7600                    | 0.1600                        | 0.2816       | 9.0000                               | 15.8400 (30)    |
| Dormer Roof                                                    | 0.8100                  |                            | 0.8100                    | 0.1800                        | 0.1458       | 9.0000                               | 7.2900 (30)     |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 81.5400                   |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 20.0505      |                                      | (33)            |
| Party Wall                                                     |                         |                            | 29.7400                   | 0.0000                        | 0.0000       | 20.0000                              | 594.8000 (32)   |
| Party Floor                                                    |                         |                            | 47.7400                   |                               |              | 30.0000                              | 1432.2000 (32d) |
| Internal Walls                                                 |                         |                            | 69.7400                   |                               |              | 9.0000                               | 627.6600 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 3322.1000 (34)  |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 69.5873 (35)    |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 7.4725 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 27.5230 (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                     | 20.4106 | 20.3123 | 20.2161 | 19.7638 | 19.6792 | 19.2853 | 19.2853 | 19.2124 | 19.4371 | 19.6792 | 19.8504 | 20.0293 (38) |
| Heat transfer coeff       | 47.9336 | 47.8353 | 47.7390 | 47.2868 | 47.2022 | 46.8083 | 46.8083 | 46.7354 | 46.9601 | 47.2022 | 47.3734 | 47.5523 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 47.2864 (39) |
| HLP                       | 1.0041  | 1.0020  | 1.0000  | 0.9905  | 0.9887  | 0.9805  | 0.9805  | 0.9790  | 0.9837  | 0.9887  | 0.9923  | 0.9961 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.9905 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |         |         |         |         |         |         |                    |          |                |
|------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                        |          |          |          |         |         |         |         |         |         |                    |          | 1.6238 (42)    |
| Average daily hot water use (litres/day) |          |          |          |         |         |         |         |         |         |                    |          | 72.7658 (43)   |
| Daily hot water use                      | 80.0424  | 77.1317  | 74.2211  | 71.3105 | 68.3998 | 65.4892 | 65.4892 | 68.3998 | 71.3105 | 74.2211            | 77.1317  | 80.0424 (44)   |
| Energy conte                             | 118.7005 | 103.8162 | 107.1290 | 93.3977 | 89.6173 | 77.3329 | 71.6603 | 82.2313 | 83.2134 | 96.9772            | 105.8582 | 114.9551 (45)  |
| Energy content (annual)                  |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1144.8892 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |         |         |         |         |         |         |                    |          |                |
|                                          | 17.8051  | 15.5724  | 16.0694  | 14.0097 | 13.4426 | 11.5999 | 10.7490 | 12.3347 | 12.4820 | 14.5466            | 15.8787  | 17.2433 (46)   |
| Water storage loss:                      |          |          |          |         |         |         |         |         |         |                    |          |                |

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## Calculation Type: New Build (As Built)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

|                                                                 |          |          |          |          |          |         |         |         |         |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|---------------|
| Total storage loss                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000 (56)   |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000 (57)   |
| Combi loss                                                      | 13.9846  | 12.6175  | 13.9474  | 13.4726  | 13.9037  | 13.4343 | 13.8692 | 13.8916 | 13.4552 | 13.9293  | 13.5088  | 13.9774 (61)  |
| Total heat required for water heating calculated for each month | 132.6851 | 116.4337 | 121.0764 | 106.8703 | 103.5210 | 90.7673 | 85.5295 | 96.1228 | 96.6686 | 110.9065 | 119.3669 | 128.9325 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 132.6851 | 116.4337 | 121.0764 | 106.8703 | 103.5210 | 90.7673 | 85.5295 | 96.1228 | 96.6686 | 110.9065 | 119.3669 | 128.9325 (64) |
| Heat gains from water heating, kWh/month                        | 42.9641  | 37.6733  | 39.1073  | 34.4229  | 33.2737  | 29.0718 | 27.2944 | 30.8148 | 31.0323 | 35.7272  | 38.5750  | 41.7169 (65)  |

#### 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                                                                               | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 33.0993  | 29.3985  | 23.9085  | 18.1002  | 13.5301  | 11.4227  | 12.3426  | 16.0434  | 21.5335  | 27.3417  | 31.9118  | 34.0192 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 210.9958 | 213.1852 | 207.6678 | 195.9219 | 181.0948 | 167.1594 | 157.8497 | 155.6603 | 161.1777 | 172.9236 | 187.7507 | 201.6861 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 (71) |
| Water heating gains (Table 5)                                                       | 57.7474  | 56.0614  | 52.5635  | 47.8096  | 44.7227  | 40.3775  | 36.6860  | 41.4177  | 43.1003  | 48.0205  | 53.5764  | 56.0711 (72)  |
| Total internal gains                                                                | 383.6857 | 380.4883 | 365.9830 | 343.6749 | 321.1909 | 300.8028 | 288.7216 | 294.9646 | 307.6547 | 330.1290 | 355.0821 | 373.6196 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W   |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|--------------|---------------|
| North       |          |          |          | 3.0900     | 10.6334                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 10.0416 (74) |               |
| West        |          |          |          | 4.2900     | 19.6403                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 25.7500 (80) |               |
| -----       |          |          |          |            |                                |                                   |                                    |          |          |                              |              |               |
| Solar gains | 35.7915  | 69.5623  | 115.5646 | 173.3641   | 218.8309                       | 227.3181                          | 215.0253                           | 180.0765 | 135.6873 | 82.6142                      | 44.4947      | 29.5467 (83)  |
| Total gains | 419.4772 | 450.0507 | 481.5476 | 517.0390   | 540.0218                       | 528.1210                          | 503.7469                           | 475.0412 | 443.3420 | 412.7432                     | 399.5769     | 403.1663 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |         |                           |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |                           |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |                           |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct                       | Nov     | Dec          |
| tau                                                                         | 19.2518 | 19.2913 | 19.3302 | 19.5151 | 19.5500 | 19.7146 | 19.7146 | 19.7453 | 19.6509 | 19.5500                   | 19.4794 | 19.4061      |
| alpha                                                                       | 2.2835  | 2.2861  | 2.2887  | 2.3010  | 2.3033  | 2.3143  | 2.3143  | 2.3164  | 2.3101  | 2.3033                    | 2.2986  | 2.2937       |
| util living area                                                            | 0.8764  | 0.8532  | 0.8097  | 0.7315  | 0.6224  | 0.4892  | 0.3767  | 0.4100  | 0.5832  | 0.7551                    | 0.8456  | 0.8847 (86)  |
| MIT                                                                         | 18.8865 | 19.1127 | 19.5212 | 20.0473 | 20.4943 | 20.7967 | 20.9201 | 20.9002 | 20.6775 | 20.1188                   | 19.4262 | 18.8331 (87) |
| Th 2                                                                        | 20.0800 | 20.0817 | 20.0833 | 20.0913 | 20.0927 | 20.0996 | 20.0996 | 20.1009 | 20.0970 | 20.0927                   | 20.0897 | 20.0866 (88) |
| util rest of house                                                          | 0.8645  | 0.8393  | 0.7913  | 0.7051  | 0.5841  | 0.4353  | 0.3085  | 0.3410  | 0.5307  | 0.7254                    | 0.8288  | 0.8736 (89)  |
| MIT 2                                                                       | 18.1576 | 18.3786 | 18.7754 | 19.2825 | 19.6959 | 19.9636 | 20.0581 | 20.0467 | 19.8687 | 19.3617                   | 18.6949 | 18.1107 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         | 0.5283 (91)  |
| MIT                                                                         | 18.5427 | 18.7664 | 19.1694 | 19.6865 | 20.1177 | 20.4037 | 20.5134 | 20.4976 | 20.2959 | 19.7617                   | 19.0812 | 18.4923 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |                           |         | 0.0000       |
| adjusted MIT                                                                | 18.5427 | 18.7664 | 19.1694 | 19.6865 | 20.1177 | 20.4037 | 20.5134 | 20.4976 | 20.2959 | 19.7617                   | 19.0812 | 18.4923 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 0.8411   | 0.8161   | 0.7706   | 0.6923   | 0.5853   | 0.4541   | 0.3406   | 0.3723   | 0.5429   | 0.7134       | 0.8074   | 0.8504 (94)    |
| Ext temp.            | 352.8225 | 367.3051 | 371.0995 | 357.9524 | 316.0502 | 239.8209 | 171.5592 | 176.8459 | 240.6888 | 294.4373     | 322.6096 | 342.8624 (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Month fracti         | 682.7015 | 663.3044 | 604.8242 | 510.0609 | 397.3347 | 271.6623 | 183.1821 | 191.5015 | 290.9617 | 432.4519     | 567.5913 | 679.6337 (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating        | 245.4300 | 198.9115 | 173.8912 | 109.5181 | 60.4756  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 102.6829     | 176.3868 | 250.5579 (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 1317.8540 (98) |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 27.6048 (99)   |

#### 8c. Space cooling requirement

Not applicable

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## Calculation Type: New Build (As Built)

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

|                                                                       |          |          |          |          |          |          |         |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |         |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |         |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |         |          |          |          |          |          | 90.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |         |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |         |          |          |          |          |          | 1456.1923 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov      | Dec      |                 |
| Space heating requirement                                             | 245.4300 | 198.9115 | 173.8912 | 109.5181 | 60.4756  | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 102.6829 | 176.3868 | 250.5579 | (98)            |
| Space heating efficiency (main heating system 1)                      | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 90.5000  | 90.5000  | 90.5000  | (210)           |
| Space heating fuel (main heating system)                              | 271.1934 | 219.7917 | 192.1450 | 121.0145 | 66.8239  | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 113.4618 | 194.9026 | 276.8595 | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (215)           |
| Water heating requirement                                             | 132.6851 | 116.4337 | 121.0764 | 106.8703 | 103.5210 | 90.7673  | 85.5295 | 96.1228  | 96.6686  | 110.9065 | 119.3669 | 128.9325 | (64)            |
| Efficiency of water heater (217)m                                     | 89.3507  | 89.2915  | 89.1585  | 88.8908  | 88.4533  | 87.3000  | 87.3000 | 87.3000  | 87.3000  | 88.8097  | 89.1806  | 87.3000  | (216)           |
| Fuel for water heating, kWh/month                                     | 148.4992 | 130.3972 | 135.7991 | 120.2266 | 117.0346 | 103.9717 | 97.9720 | 110.1063 | 110.7315 | 124.8811 | 133.8485 | 144.2411 | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |         |          |          |          |          |          | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |         |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |         |          |          |          |          |          | 1456.1923 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |         |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |         |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |         |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |         |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |         |          |          |          |          |          | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |         |          |          |          |          |          | 233.8175 (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |          |          |         |          |          |          |          |          |                 |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |         |          |          |          |          |          | 3242.7186 (238) |

#### 10a. Fuel costs - using Table 12 prices

|                                       | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |  |
|---------------------------------------|------------------|---------------------|---------------------|--|
| Space heating - main system 1         | 1456.1923        | 3.4800              | 50.6755 (240)       |  |
| Space heating - secondary             | 0.0000           | 0.0000              | 0.0000 (242)        |  |
| Water heating (other fuel)            | 1477.7088        | 3.4800              | 51.4243 (247)       |  |
| Pumps and fans for heating            | 75.0000          | 13.1900             | 9.8925 (249)        |  |
| Energy for lighting                   | 233.8175         | 13.1900             | 30.8405 (250)       |  |
| Additional standing charges           |                  |                     | 120.0000 (251)      |  |
| Energy saving/generation technologies |                  |                     |                     |  |
| PV Unit                               | 0.0000           | 13.1900             | 0.0000 (252)        |  |
| Total energy cost                     |                  |                     | 262.8328 (255)      |  |

#### 11a. SAP rating - Individual heating systems

|                                  |                                         |              |
|----------------------------------|-----------------------------------------|--------------|
| Energy cost deflator (Table 12): |                                         | 0.4200 (256) |
| Energy cost factor (ECF)         |                                         | 1.1903 (257) |
| SAP value                        | $[(255) \times (256)] / [(4) + 45.0] =$ | 83.3951      |
| SAP rating (Section 12)          |                                         | 83 (258)     |
| SAP band                         |                                         | B            |

#### 12a. Carbon dioxide 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         | 1456.1923          | 0.2160                        | 314.5375 (261)           |  |
| Space heating - secondary             | 0.0000             | 0.0000                        | 0.0000 (263)             |  |
| Water heating (other fuel)            | 1477.7088          | 0.2160                        | 319.1851 (264)           |  |
| Space and water heating               |                    |                               | 633.7226 (265)           |  |
| Pumps and fans                        | 75.0000            | 0.5190                        | 38.9250 (267)            |  |
| Energy for lighting                   | 233.8175           | 0.5190                        | 121.3513 (268)           |  |
| Energy saving/generation technologies |                    |                               |                          |  |
| PV Unit                               | -303.4800          | 0.5190                        | -157.5061 (269)          |  |
| Total kg/year                         |                    |                               | 636.4928 (272)           |  |
| CO2 emissions per m2                  |                    |                               | 13.3300 (273)            |  |
| EI value                              |                    |                               | 90.8033                  |  |
| EI rating                             |                    |                               | 91 (274)                 |  |
| EI band                               |                    |                               | B                        |  |

#### Calculation of stars for heating and DHW

|                                    |                                                                     |
|------------------------------------|---------------------------------------------------------------------|
| Main heating energy efficiency     | $3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$ , stars = 4   |
| Main heating environmental impact  | $0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$ , stars = 4 |
| Water heating energy efficiency    | $3.48 / 0.8848 = 3.933$ , stars = 4                                 |
| Water heating environmental impact | $0.216 / 0.8848 = 0.2441$ , stars = 4                               |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 47.7400 (1b)              | x 2.2700 (2b)                   | = 108.3698 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 47.7400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 108.3698 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 20.0000 / (5) = 0.1846 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                        |
| Measured/design AP50                                 |                              |                      |       |       | 3.2500                     |
| Infiltration rate                                    |                              |                      |       |       | 0.3471 (18)                |
| Number of sides sheltered                            |                              |                      |       |       | 2 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.2950 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 4.4000 | 4.1000 | 4.1000 | 3.9000 | 3.9000 | 3.7000 | 3.7000 | 3.5000 | 3.5000 | 3.8000 | 3.7000 | 3.9000 (22)  |
| Wind factor     | 1.1000 | 1.0250 | 1.0250 | 0.9750 | 0.9750 | 0.9250 | 0.9250 | 0.8750 | 0.8750 | 0.9500 | 0.9250 | 0.9750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.3245 | 0.3024 | 0.3024 | 0.2876 | 0.2876 | 0.2729 | 0.2729 | 0.2581 | 0.2581 | 0.2802 | 0.2729 | 0.2876 (22b) |
| Effective ac    | 0.5526 | 0.5457 | 0.5457 | 0.5414 | 0.5414 | 0.5372 | 0.5372 | 0.5333 | 0.5333 | 0.5393 | 0.5372 | 0.5414 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| Windows (Uw = 1.40)                                            |                         |                            | 7.3800                    | 1.3258                        | 9.7841       |                                      | (27)            |
| External Wall                                                  | 34.1800                 | 7.3800                     | 26.8000                   | 0.2000                        | 5.3600       | 9.0000                               | 241.2000 (29a)  |
| Pitched Roof                                                   | 44.7900                 |                            | 44.7900                   | 0.1000                        | 4.4790       | 9.0000                               | 403.1100 (30)   |
| Sloping Roof                                                   | 1.7600                  |                            | 1.7600                    | 0.1600                        | 0.2816       | 9.0000                               | 15.8400 (30)    |
| Dormer Roof                                                    | 0.8100                  |                            | 0.8100                    | 0.1800                        | 0.1458       | 9.0000                               | 7.2900 (30)     |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 81.5400                   |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 20.0505      |                                      | (33)            |
| Party Wall                                                     |                         |                            | 29.7400                   | 0.0000                        | 0.0000       | 20.0000                              | 594.8000 (32)   |
| Party Floor                                                    |                         |                            | 47.7400                   |                               |              | 30.0000                              | 1432.2000 (32d) |
| Internal Walls                                                 |                         |                            | 69.7400                   |                               |              | 9.0000                               | 627.6600 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 3322.1000 (34)  |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 69.5873 (35)    |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 7.4725 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 27.5230 (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                     | 19.7638 | 19.5158 | 19.5158 | 19.3602 | 19.3602 | 19.2124 | 19.2124 | 19.0724 | 19.0724 | 19.2853 | 19.2124 | 19.3602 (38) |
| Heat transfer coeff       | 47.2868 | 47.0388 | 47.0388 | 46.8832 | 46.8832 | 46.7354 | 46.7354 | 46.5954 | 46.5954 | 46.8083 | 46.7354 | 46.8832 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 46.8516 (39) |
| HLP                       | 0.9905  | 0.9853  | 0.9853  | 0.9821  | 0.9821  | 0.9790  | 0.9790  | 0.9760  | 0.9760  | 0.9805  | 0.9790  | 0.9821 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.9814 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |         |         |         |         |         |         |                    |          |                |
|------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                        |          |          |          |         |         |         |         |         |         |                    |          | 1.6238 (42)    |
| Average daily hot water use (litres/day) |          |          |          |         |         |         |         |         |         |                    |          | 72.7658 (43)   |
| Daily hot water use                      | 80.0424  | 77.1317  | 74.2211  | 71.3105 | 68.3998 | 65.4892 | 65.4892 | 68.3998 | 71.3105 | 74.2211            | 77.1317  | 80.0424 (44)   |
| Energy conte                             | 118.7005 | 103.8162 | 107.1290 | 93.3977 | 89.6173 | 77.3329 | 71.6603 | 82.2313 | 83.2134 | 96.9772            | 105.8582 | 114.9551 (45)  |
| Energy content (annual)                  |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1144.8892 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |         |         |         |         |         |         |                    |          |                |
|                                          | 17.8051  | 15.5724  | 16.0694  | 14.0097 | 13.4426 | 11.5999 | 10.7490 | 12.3347 | 12.4820 | 14.5466            | 15.8787  | 17.2433 (46)   |
| Water storage loss:                      |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

|                                                                 |          |          |          |          |          |         |         |         |         |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|---------------|
| Total storage loss                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000 (56)   |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000 (57)   |
| Combi loss                                                      | 13.9846  | 12.6175  | 13.9474  | 13.4726  | 13.9037  | 13.4343 | 13.8692 | 13.8916 | 13.4552 | 13.9293  | 13.5088  | 13.9774 (61)  |
| Total heat required for water heating calculated for each month | 132.6851 | 116.4337 | 121.0764 | 106.8703 | 103.5210 | 90.7673 | 85.5295 | 96.1228 | 96.6686 | 110.9065 | 119.3669 | 128.9325 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 132.6851 | 116.4337 | 121.0764 | 106.8703 | 103.5210 | 90.7673 | 85.5295 | 96.1228 | 96.6686 | 110.9065 | 119.3669 | 128.9325 (64) |
| Heat gains from water heating, kWh/month                        | 42.9641  | 37.6733  | 39.1073  | 34.4229  | 33.2737  | 29.0718 | 27.2944 | 30.8148 | 31.0323 | 35.7272  | 38.5750  | 41.7169 (65)  |

#### 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                                                                               | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294  | 97.4294 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 33.0993  | 29.3985  | 23.9085  | 18.1002  | 13.5301  | 11.4227  | 12.3426  | 16.0434  | 21.5335  | 27.3417  | 31.9118  | 34.0192 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 210.9958 | 213.1852 | 207.6678 | 195.9219 | 181.0948 | 167.1594 | 157.8497 | 155.6603 | 161.1777 | 172.9236 | 187.7507 | 201.6861 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668  | 46.3668 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 | -64.9529 (71) |
| Water heating gains (Table 5)                                                       | 57.7474  | 56.0614  | 52.5635  | 47.8096  | 44.7227  | 40.3775  | 36.6860  | 41.4177  | 43.1003  | 48.0205  | 53.5764  | 56.0711 (72)  |
| Total internal gains                                                                | 383.6857 | 380.4883 | 365.9830 | 343.6749 | 321.1909 | 300.8028 | 288.7216 | 294.9646 | 307.6547 | 330.1290 | 355.0821 | 373.6196 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|----------|------------------------------------|------------------------------|----------|--------------|---------------|
| North       |          |          |          | 3.0900     | 13.4839                        | 0.6300                            |          | 0.7000                             | 0.7700                       |          | 12.7334 (74) |               |
| West        |          |          |          | 4.2900     | 25.1925                        | 0.6300                            |          | 0.7000                             | 0.7700                       |          | 33.0294 (80) |               |
| -----       |          |          |          |            |                                |                                   |          |                                    |                              |          |              |               |
| Solar gains | 45.7629  | 75.9132  | 127.3579 | 192.0130   | 228.6638                       | 260.0782                          | 237.4916 | 208.0071                           | 156.7462                     | 96.1340  | 56.7588      | 35.7254 (83)  |
| Total gains | 429.4485 | 456.4016 | 493.3409 | 535.6879   | 549.8547                       | 560.8811                          | 526.2132 | 502.9717                           | 464.4009                     | 426.2630 | 411.8409     | 409.3451 (84) |
| -----       |          |          |          |            |                                |                                   |          |                                    |                              |          |              |               |

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

|                                                                             |         |         |         |         |         |         |         |         |         |                           |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |                           |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct                       | Nov     | Dec          |
| tau                                                                         | 19.5151 | 19.6180 | 19.6180 | 19.6831 | 19.6831 | 19.7453 | 19.7453 | 19.8047 | 19.8047 | 19.7146                   | 19.7453 | 19.6831      |
| alpha                                                                       | 2.3010  | 2.3079  | 2.3079  | 2.3122  | 2.3122  | 2.3164  | 2.3164  | 2.3203  | 2.3203  | 2.3143                    | 2.3164  | 2.3122       |
| util living area                                                            | 0.8554  | 0.8324  | 0.7777  | 0.6847  | 0.5528  | 0.3892  | 0.2808  | 0.2919  | 0.4925  | 0.6942                    | 0.8109  | 0.8638 (86)  |
| MIT                                                                         | 19.1809 | 19.3732 | 19.7855 | 20.2656 | 20.6724 | 20.9010 | 20.9681 | 20.9656 | 20.8177 | 20.3812                   | 19.7412 | 19.1601 (87) |
| Th 2                                                                        | 20.0913 | 20.0956 | 20.0956 | 20.0983 | 20.0983 | 20.1009 | 20.1009 | 20.1034 | 20.1034 | 20.0996                   | 20.1009 | 20.0983 (88) |
| util rest of house                                                          | 0.8413  | 0.8163  | 0.7561  | 0.6539  | 0.5077  | 0.3294  | 0.2085  | 0.2173  | 0.4316  | 0.6564                    | 0.7900  | 0.8503 (89)  |
| MIT 2                                                                       | 18.4534 | 18.6421 | 19.0381 | 19.4911 | 19.8569 | 20.0438 | 20.0887 | 20.0901 | 19.9877 | 19.6095                   | 19.0070 | 18.4395 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         | 0.5283 (91)  |
| MIT                                                                         | 18.8377 | 19.0283 | 19.4329 | 19.9002 | 20.2877 | 20.4966 | 20.5532 | 20.5526 | 20.4262 | 20.0172                   | 19.3949 | 18.8202 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |                           |         | 0.0000       |
| adjusted MIT                                                                | 18.8377 | 19.0283 | 19.4329 | 19.9002 | 20.2877 | 20.4966 | 20.5532 | 20.5526 | 20.4262 | 20.0172                   | 19.3949 | 18.8202 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 351.5698 | 362.6528 | 364.3629 | 346.4269 | 284.5750 | 199.8501 | 129.1626 | 128.4037 | 210.9913 | 278.2210     | 317.6643 | 338.8328 (95)  |
| Ext temp.            | 5.4000   | 5.9000   | 7.6000   | 10.0000  | 13.1000  | 15.9000  | 17.7000  | 17.7000  | 15.3000  | 12.0000      | 8.4000   | 5.5000 (96)    |
| Heat loss rate W     | 635.4271 | 617.5410 | 556.6078 | 464.1555 | 336.9828 | 214.8237 | 133.3477 | 132.9172 | 238.8566 | 375.2714     | 513.8497 | 624.4943 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 211.1898 | 171.2849 | 143.0302 | 84.7645  | 38.9914  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 72.2055      | 141.2535 | 212.5321 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1075.2520 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 22.5231 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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

|                                                                       |          |          |          |          |          |          |         |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |         |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |         |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |         |          |          |          |          |           | 90.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |         |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |         |          |          |          |          |           | 1188.1238 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 211.1898 | 171.2849 | 143.0302 | 84.7645  | 38.9914  | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 72.2055  | 141.2535 | 212.5321  | (98)            |
| Space heating efficiency (main heating system 1)                      | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 90.5000  | 90.5000  | 90.5000   | (210)           |
| Space heating fuel (main heating system)                              | 233.3589 | 189.2650 | 158.0444 | 93.6625  | 43.0845  | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 79.7851  | 156.0812 | 234.8421  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating                                                         |          |          |          |          |          |          |         |          |          |          |          |           |                 |
| Water heating requirement                                             | 132.6851 | 116.4337 | 121.0764 | 106.8703 | 103.5210 | 90.7673  | 85.5295 | 96.1228  | 96.6686  | 110.9065 | 119.3669 | 128.9325  | (64)            |
| Efficiency of water heater (217)m                                     | 89.2379  | 89.1772  | 89.0044  | 88.6871  | 88.1528  | 87.3000  | 87.3000 | 87.3000  | 87.3000  | 88.5344  | 89.0057  | 87.3000   | (216)           |
| Fuel for water heating, kWh/month                                     | 148.6870 | 130.5644 | 136.0343 | 120.5027 | 117.4336 | 103.9717 | 97.9720 | 110.1063 | 110.7315 | 125.2693 | 134.1115 | 144.4387  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |         |          |          |          |          | 1479.8230 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |         |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |         |          |          |          |          | 1188.1238 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |         |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |         |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |         |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |         |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |         |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |         |          |          |          |          | 233.8175  | (232)           |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |          |          |         |          |          |          |          |           |                 |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |         |          |          |          |          | 2976.7642 | (238)           |

#### 10a. Fuel costs - using BEDF prices (£10)

|                                       | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |
|---------------------------------------|------------------|---------------------|---------------------|
| Space heating - main system 1         | 1188.1238        | 4.2600              | 50.6141 (240)       |
| Space heating - secondary             | 0.0000           | 0.0000              | 0.0000 (242)        |
| Water heating (other fuel)            | 1479.8230        | 4.2600              | 63.0405 (247)       |
| Pumps and fans for heating            | 75.0000          | 22.5500             | 16.9125 (249)       |
| Energy for lighting                   | 233.8175         | 22.5500             | 52.7258 (250)       |
| Additional standing charges           |                  |                     | 96.0000 (251)       |
| Energy saving/generation technologies |                  |                     |                     |
| PV Unit                               | 0.0000           | 22.5500             | 0.0000 (252)        |
| Total energy cost                     |                  |                     | 279.2929 (255)      |

#### 12a. Carbon dioxide 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         | 1188.1238          | 0.2160                        | 256.6347 (261)           |
| Space heating - secondary             | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)            | 1479.8230          | 0.2160                        | 319.6418 (264)           |
| Space and water heating               |                    |                               | 576.2765 (265)           |
| Pumps and fans                        | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                   | 233.8175           | 0.5190                        | 121.3513 (268)           |
| Energy saving/generation technologies |                    |                               |                          |
| PV Unit                               | -303.4800          | 0.5190                        | -157.5061 (269)          |
| Total kg/year                         |                    |                               | 579.0466 (272)           |

#### 13a. Primary energy - Individual heating systems including micro-CHP

|                                       | Energy<br>kWh/year | Primary energy factor<br>kg CO2/kWh | Primary energy<br>kWh/year |
|---------------------------------------|--------------------|-------------------------------------|----------------------------|
| Space heating - main system 1         | 1188.1238          | 1.2200                              | 1449.5110 (261)            |
| Space heating - secondary             | 0.0000             | 0.0000                              | 0.0000 (263)               |
| Water heating (other fuel)            | 1479.8230          | 1.2200                              | 1805.3840 (264)            |
| Space and water heating               |                    |                                     | 3254.8950 (265)            |
| Pumps and fans                        | 75.0000            | 3.0700                              | 230.2500 (267)             |
| Energy for lighting                   | 233.8175           | 3.0700                              | 717.8196 (268)             |
| Energy saving/generation technologies |                    |                                     |                            |
| PV Unit                               | -303.4800          | 3.0700                              | -931.6836 (269)            |
| Primary energy kWh/year               |                    |                                     | 3271.2810 (272)            |
| Primary energy kWh/m2/year            |                    |                                     | 68.5229 (273)              |

#### SAP 2012 EPC IMPROVEMENTS

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Current energy efficiency rating: B 83  
Current environmental impact rating: B 91

|                             |                   |
|-----------------------------|-------------------|
| (For testing purposes):     |                   |
| A                           | Not considered    |
| B                           | Not considered    |
| C                           | Not considered    |
| D                           | Not considered    |
| E Low energy lighting       | Already installed |
| F                           | Not considered    |
| G                           | Not considered    |
| H                           | Not considered    |
| I                           | Not considered    |
| J                           | Not considered    |
| K                           | Not considered    |
| M                           | Not considered    |
| N Solar water heating       | Not applicable    |
| O                           | Not considered    |
| P                           | Not considered    |
| R                           | Not considered    |
| S                           | Not considered    |
| T                           | Not considered    |
| U Solar photovoltaic panels | Not applicable    |
| A2                          | Not considered    |
| A3                          | Not considered    |
| T2                          | Not considered    |
| W                           | Not considered    |
| X                           | Not considered    |
| Y                           | Not considered    |
| J2                          | Not considered    |
| Q2                          | Not considered    |
| Z1                          | Not considered    |
| Z2                          | Not considered    |
| Z3                          | Not considered    |
| Z4                          | Not considered    |
| Z5                          | Not considered    |
| V2 Wind turbine             | Not applicable    |
| L2                          | Not considered    |
| Q3                          | Not considered    |
| O3                          | Not considered    |

|                       |            |             |            |
|-----------------------|------------|-------------|------------|
| Recommended measures: | SAP change | Cost change | CO2 change |
| (none)                |            |             |            |

|                      |                        |                   |                      |
|----------------------|------------------------|-------------------|----------------------|
| Recommended measures | Typical annual savings | Energy efficiency | Environmental impact |
| (none)               |                        |                   |                      |
| Total Savings        | £0                     | 0.00 kg/m²        |                      |

Potential energy efficiency rating: B 83  
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 510 TEST (21 Dec 2022)  
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

|                          | Current    | Potential  | Saving     |
|--------------------------|------------|------------|------------|
| Electricity              | £70        | £70        | £0         |
| Mains gas                | £210       | £210       | £0         |
| Space heating            | £164       | £164       | £0         |
| Water heating            | £63        | £63        | £0         |
| Lighting                 | £53        | £53        | £0         |
| Total cost of fuels      | £280       | £280       | £0         |
| Total cost of uses       | £280       | £280       | £0         |
| Delivered energy         | 62 kWh/m²  | 62 kWh/m²  | 0 kWh/m²   |
| Carbon dioxide emissions | 0.6 tonnes | 0.6 tonnes | 0.0 tonnes |
| CO2 emissions per m²     | 12 kg/m²   | 12 kg/m²   | 0 kg/m²    |
| Primary energy           | 69 kWh/m²  | 69 kWh/m²  | 0 kWh/m²   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)  
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014  
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No improvements selected / applicable

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

#### Overheating Calculation Input Data

|                                           |                                              |
|-------------------------------------------|----------------------------------------------|
| Dwelling type                             | MidTerrace Flat                              |
| Number of storeys                         | 1                                            |
| Cross ventilation possible                | Yes                                          |
| SAP Region                                | Southern England                             |
| Front of dwelling faces                   | East                                         |
| Overshading                               | Average or unknown                           |
| Thermal mass parameter                    | 69.6 (calculated from construction elements) |
| Night ventilation                         | Yes                                          |
| Ventilation rate during hot weather (ach) | 6.00 (Windows fully open)                    |

#### Overheating Calculation

|                                          |             |
|------------------------------------------|-------------|
| Summer ventilation heat loss coefficient | 214.57 (P1) |
| Transmission heat loss coefficient       | 27.52 (37)  |
| Summer heat loss coefficient             | 242.10 (P2) |

| Overhangs   | Ratio | Z_overhangs | Overhang type |
|-------------|-------|-------------|---------------|
| Orientation |       |             |               |
| North       | 0.000 | 1.000       | None          |
| West        | 0.000 | 1.000       | None          |

  

| Solar shading | Z blinds | Solar access | Z overhangs | Z summer   |
|---------------|----------|--------------|-------------|------------|
| Orientation   |          |              |             |            |
| North         | 1.000    | 0.90         | 1.000       | 0.900 (P8) |
| West          | 1.000    | 0.90         | 1.000       | 0.900 (P8) |

  

| [Jul]  | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Shading | Gains<br>W |
|--------|------------|--------------------------------|-----------------------------------|------------------------------------|---------|------------|
| North  | 3.0900     | 87.1704                        | 0.6300                            | 0.7000                             | 0.9000  | 96.2169    |
| West   | 4.2900     | 125.2818                       | 0.6300                            | 0.7000                             | 0.9000  | 191.9857   |
| total: |            |                                |                                   |                                    |         | 288.2026   |

|                                                        |                 |        |        |      |
|--------------------------------------------------------|-----------------|--------|--------|------|
|                                                        | Jun             | Jul    | Aug    |      |
| Solar gains                                            | 312             | 288    | 247    | (P3) |
| Internal gains                                         | 298             | 286    | 292    |      |
| Total summer gains                                     | 610             | 574    | 539    | (P5) |
| Summer gain/loss ratio                                 | 2.52            | 2.37   | 2.23   | (P6) |
| Summer external temperature                            | 15.40           | 17.30  | 17.30  |      |
| Thermal mass temperature increment (TMP = 69.6)        | 1.51            | 1.51   | 1.51   |      |
| Threshold temperature                                  | 19.43           | 21.18  | 21.04  | (P7) |
| Likelihood of high internal temperature                | Not significant | Slight | Slight |      |
| Assessment of likelihood of high internal temperature: | Slight          |        |        |      |