



## SAP Report Submission for Building Regulations Compliance

Client: Highwood Construction Ltd

Project: 89 Highwood Avenue, North Stoneham Park  
EASTLEIGH, SO50 9QY

Contact: Scott Spearing | BEAT Solutions  
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Report Issue Date: 16/03/2023

EXCELLENCE  
IN ENERGY  
ASSESSMENT

# BASIC COMPLIANCE REPORT

## Calculation Type: New Build (As Built)

|                                    |                                                                                  |               |       |      |                |            |
|------------------------------------|----------------------------------------------------------------------------------|---------------|-------|------|----------------|------------|
| Property Reference                 | SAP-0796 (3B4A) - Plot 209                                                       |               |       |      | Issued on Date | 16/03/2023 |
| Assessment Reference               | AB                                                                               | Prop Type Ref | FOG 3 |      |                |            |
| Property                           | 89 Highwood Avenue, North Stoneham Park, EASTLEIGH, SO50 9QY                     |               |       |      |                |            |
| SAP Rating                         | 86 B                                                                             | DER           | 14.92 | TER  | 18.43          |            |
| Environmental                      | 86 B                                                                             | % DER<TER     | 19.05 |      |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.52                                                                             | DFEE          | 50.24 | TFEE | 64.23          |            |
| General Requirements Compliance    | Pass                                                                             | % DFEE<TFEE   | 21.78 |      |                |            |
| 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)   | 18.43            | kgCO <sub>2</sub> /m <sup>2</sup> |      |
| Dwelling Carbon Dioxide Emission Rate (DER) | 14.92            | kgCO <sub>2</sub> /m <sup>2</sup> | Pass |
|                                             | -3.51 (-19.0%)   | kgCO <sub>2</sub> /m <sup>2</sup> |      |

##### 1b TFEE and DFEE

|                                          |                |                        |      |
|------------------------------------------|----------------|------------------------|------|
| Target Fabric Energy Efficiency (TFEE)   | 64.23          | kWh/m <sup>2</sup> /yr |      |
| Dwelling Fabric Energy Efficiency (DFEE) | 50.24          | kWh/m <sup>2</sup> /yr |      |
|                                          | -14.0 (-21.8%) | 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 |
| Floor         | 0.16 (max. 0.25) | 0.18 (max. 0.70) | Pass |
| Roof          | 0.10 (max. 0.20) | 0.10 (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 | 5.18 (measured in this dwelling) |      |
| Maximum                        | 10.0                             | Pass |

##### Limiting System Efficiencies

##### 4 Heating efficiency

# BASIC COMPLIANCE REPORT

## Calculation Type: New Build (As Built)

Main heating system

Boiler system with radiators or underfloor - Mains gas  
Data from database  
Ideal Heating LOGIC HEAT2 H15  
  
Efficiency: 89.4% SEDBUK2009  
Minimum: 88.0%

Pass

Secondary heating system

None

### 5 Cylinder insulation

Hot water storage

Measured cylinder loss: 1.40 kWh/day  
Permitted by DBSCG 2.27

Pass

Primary pipework insulated

Yes

Pass

### 6 Controls

Space heating controls

Programmer, room thermostat and TRVs

Pass

Hot water controls

Cylinderstat

Pass

Independent timer for DHW

Pass

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)

Not significant

Pass

Based on:

Overshading

Average

Windows facing East

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

Windows facing West

8.53 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

5.18 (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

Photovoltaic array

0.96

kW

# BASIC COMPLIANCE REPORT

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

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

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

#### 6.0 Measurements

|               | Heat Loss Perimeter | Internal Floor Area   | Average Storey Height |
|---------------|---------------------|-----------------------|-----------------------|
| Ground Floor: | 18.15 m             | 11.83 m <sup>2</sup>  | 2.40 m                |
| 1st Storey:   | 40.85 m             | 114.22 m <sup>2</sup> | 2.40 m                |

|                 |       |                |
|-----------------|-------|----------------|
| 7.0 Living Area | 44.25 | m <sup>2</sup> |
|-----------------|-------|----------------|

|                            |                     |        |
|----------------------------|---------------------|--------|
| 8.0 Thermal Mass Parameter | Precise calculation |        |
| Thermal Mass               | 55.4                | kJ/m²K |

#### 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                        | 141.60                       | 123.36                      |

#### 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                       | 16.32                  |

#### 9.2 Internal Walls

| Description        | Construction                 | Kappa (kJ/m <sup>2</sup> K) | Area (m <sup>2</sup> ) |
|--------------------|------------------------------|-----------------------------|------------------------|
| Internal Wall - FF | Plasterboard on timber frame | 9.00                        | 152.28                 |

#### 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> ) |
|---------------|---------------------|------------------------------------------|------------------------------|-----------------------------|------------------------------|-----------------------------|
| External Roof | External Plane Roof | Plasterboard, insulated at ceiling level | 0.10                         | 9.00                        | 114.22                       | 114.22                      |

#### 10.2 Internal Ceilings

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Built)

| Description      | Construction                                   | Kappa<br>(kJ/m²K) | Area<br>(m²) |
|------------------|------------------------------------------------|-------------------|--------------|
| Internal Ceiling | Plasterboard ceiling, carpeted chipboard floor | 9.00              | 11.83        |

### 11.0 Heat Loss Floors

| Description     | Type                   | Construction                                    | U-Value<br>(W/m²K) | Kappa<br>(kJ/m²K) | Area<br>(m²) |
|-----------------|------------------------|-------------------------------------------------|--------------------|-------------------|--------------|
| Ground Floor    | Ground Floor - Solid   | Suspended concrete floor, carpeted              | 0.18               | 75.00             | 11.83        |
| Suspended Floor | Exposed Floor - Timber | Timber exposed floor, insulation between joists | 0.16               | 20.00             | 102.39       |

### 12.0 Opening Types

| Description | Data Source  | Type       | Glazing                | Glazing Gap | Argon Filled | G-value | Frame Type | Frame Factor | U Value<br>(W/m²K) |
|-------------|--------------|------------|------------------------|-------------|--------------|---------|------------|--------------|--------------------|
| Solid Doors | Manufacturer | Solid Door |                        |             |              |         |            |              | 1.40               |
| Windows     | Manufacturer | 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 |
|-----------------|--------------|-------------------|-------------|--------------|----------------|---------------|-----------|------------|-------|-----------|----------------|
| Front Door      | Solid Door   | [1] External Wall | West        |              |                |               |           |            |       | 2.16      |                |
| Front Elevation | Window       | [1] External Wall | West        | None         | 0.00           |               |           |            |       | 8.53      |                |
| Rear Elevation  | Window       | [1] External Wall | East        | None         | 0.00           |               |           |            |       | 7.55      |                |

### 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 | Reference: |
|------------------------|---------------------------------------------------------------------------|--------|--------|----------|------------|
| Independently assessed | E2 Other lintels (including other steel lintels)                          | 14.42  | 0.088  | Yes      | TLD 08.0   |
| Independently assessed | E3 Sill                                                                   | 13.40  | 0.030  | Yes      | TLD 10.0   |
| Independently assessed | E4 Jamb                                                                   | 32.66  | 0.037  | Yes      | TLD 11.0   |
| Independently assessed | E5 Ground floor (normal)                                                  | 13.44  | 0.135  | No       | TLD 01.0   |
| Table K1 - Default     | E20 Exposed floor (normal)                                                | 29.56  | 0.320  | No       |            |
| Independently assessed | E6 Intermediate floor within a dwelling                                   | 11.29  | 0.065  | No       | TLD 12.0   |
| Table K1 - Approved    | E10 Eaves (insulation at ceiling level)                                   | 30.40  | 0.060  | No       |            |
| Independently assessed | E12 Gable (insulation at ceiling level)                                   | 1.45   | 0.069  | No       | TLD 16.0   |
| Independently assessed | E16 Corner (normal)                                                       | 24.00  | 0.055  | No       | TLD 05.0   |
| Table K1 - Approved    | E17 Corner (inverted – internal area greater than external area)          | 9.60   | -0.090 | No       |            |
| Independently assessed | E18 Party wall between dwellings                                          | 4.80   | 0.019  | No       | TLD 07.0   |
| Table K1 - Default     | P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 6.80   | 0.000  | No       |            |
| Table K1 - Default     | P7 Party Wall - Exposed floor (normal)                                    | 6.80   | 0.160  | No       |            |

|         |       |       |
|---------|-------|-------|
| Y-value | 0.050 | W/m²K |
|---------|-------|-------|

### 18.0 Pressure Testing

|                           |      |                   |
|---------------------------|------|-------------------|
| Designed AP <sub>50</sub> | 6.00 | m³/(h.m²) @ 50 Pa |
| Property Tested ?         | Yes  |                   |
| As Built AP <sub>50</sub> | 5.18 | 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                |

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Built)

Air change rate

### Mechanical Ventilation

Mechanical Ventilation System Present

### 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  |     |     |       | 3     |
| Number of passive vents      |     |     |       | 0     |
| Number of flueless gas fires |     |     |       | 0     |

### 21.0 Fixed Cooling System

### 22.0 Lighting

#### Internal

Total number of light fittings

Total number of L.E.L. fittings

Percentage of L.E.L. fittings  %

#### External

External lights fitted

### 23.0 Electricity Tariff

### 24.0 Main Heating 1

Description

Percentage of Heat  %

Database Ref. No.

Fuel Type

Main Heating

SAP Code

In Winter

In Summer

Controls

PCDF Controls

Delayed Start Stat

Sap Code

Flue Type

Fan Assisted Flue

Is MHS Pumped

Heat Emitter

Flow Temperature

### 25.0 Main Heating 2

Community Heating

### 28.0 Water Heating

Water Heating

Flue Gas Heat Recovery System

Waste Water Heat Recovery Instantaneous System 1

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Built)

|                                                  |                                                               |                  |                    |                              |
|--------------------------------------------------|---------------------------------------------------------------|------------------|--------------------|------------------------------|
| Waste Water Heat Recovery Instantaneous System 2 | <input type="text" value="No"/>                               |                  |                    |                              |
| Waste Water Heat Recovery Storage System         | <input type="text" value="No"/>                               |                  |                    |                              |
| Solar Panel                                      | <input type="text" value="No"/>                               |                  |                    |                              |
| Water use <= 125 litres/person/day               | <input type="text" value="Yes"/>                              |                  |                    |                              |
| SAP Code                                         | <input type="text" value="901"/>                              |                  |                    |                              |
| <hr/>                                            |                                                               |                  |                    |                              |
| <b>29.0 Hot Water Cylinder</b>                   | <input type="text" value="Hot Water Cylinder"/>               |                  |                    |                              |
| Cylinder Stat                                    | <input type="text" value="Yes"/>                              |                  |                    |                              |
| Cylinder In Heated Space                         | <input type="text" value="Yes"/>                              |                  |                    |                              |
| Independent Time Control                         | <input type="text" value="Yes"/>                              |                  |                    |                              |
| Insulation Type                                  | <input type="text" value="Measured Loss"/>                    |                  |                    |                              |
| Cylinder Volume                                  | <input type="text" value="205.00"/>                           | L                |                    |                              |
| Loss                                             | <input type="text" value="1.40"/>                             | kWh/day          |                    |                              |
| Pipes insulation                                 | <input type="text" value="Fully insulated primary pipework"/> |                  |                    |                              |
| <hr/>                                            |                                                               |                  |                    |                              |
| <b>31.0 Thermal Store</b>                        | <input type="text" value="None"/>                             |                  |                    |                              |
| <hr/>                                            |                                                               |                  |                    |                              |
| <b>32.0 Photovoltaic Unit</b>                    | <input type="text" value="One Dwelling"/>                     |                  |                    |                              |
| <b>PV Cells kWp</b>                              | <b>Orientation</b>                                            | <b>Elevation</b> | <b>Overshading</b> | <b>Connected to Dwelling</b> |
| 0.96                                             | East                                                          | 45°              | None Or Little     | Yes                          |

### Recommendations

#### Lower cost measures

None

#### Further measures to achieve even higher standards

None

# U-VALUE CALCULATOR REPORT

|                      |                                                              |                |            |
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## Building Elements

### Roof Pitched Roof - 400mm Quilt

#### 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                                          | 300            | 0.0400                            | 7.5000                          | 100.00       |
|             | Corrections - Air Gap: Level 0, Fasteners: None or plastic |                |                                   |                                 |              |
| Layer 2     | <b>Mineral wool</b>                                        |                |                                   |                                 |              |
|             | Main construction                                          | 100            | 0.0400                            | 2.5000                          | 92.17        |
|             | Main construction                                          | 100            | 0.1300                            | 0.7692                          | 7.83         |
|             | 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 = 10.046 m <sup>2</sup> K/W      | Lower limit = 9.832 m <sup>2</sup> K/W       | Average = 9.939 m <sup>2</sup> K/W |
|                   | Total correction = 0.0005 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

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|                      |                                                              |               |                |            |
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## 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/m <sup>2</sup> K) | Resistance<br>(m <sup>2</sup> K/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 m<sup>2</sup> K/W Lower limit = 4.778 m<sup>2</sup> K/W Average = 5.128 m<sup>2</sup> K/W  
Total correction = 0.0041 m<sup>2</sup> K/W U-value (unrounded) = 0.2 W/m<sup>2</sup> K

Unheated space: None

Total thickness: 342 mm

U-value: 0.20 W/m<sup>2</sup> K

Kappa: n/a

# U-VALUE CALCULATOR REPORT

|                      |                                                              |                |            |
|----------------------|--------------------------------------------------------------|----------------|------------|
| Property Reference   | SAP-0796 (3B4A) - Plot 209                                   | Issued on Date | 16/03/2023 |
| Assessment Reference | AB                                                           | Prop Type Ref  | FOG 3      |
| Project              | 89 Highwood Avenue, North Stoneham Park, EASTLEIGH, SO50 9QY |                |            |
| Calculation Type     | New Build (As Built)                                         |                |            |

|                                    |      |             |       |      |       |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating                         | 86 B | DER         | 14.92 | TER  | 18.43 |
| Environmental                      | 86 B | % DER<TER   | 19.05 |      |       |
| CO <sub>2</sub> Emissions (t/year) | 1.52 | DFEE        | 50.24 | TFEE | 64.23 |
| General Requirements Compliance    | Pass | % DFEE<TFEE | 21.78 |      |       |

|                  |                                                                                     |             |           |
|------------------|-------------------------------------------------------------------------------------|-------------|-----------|
| Assessor Details | Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920,<br>scott@beatsolutions.co.uk | Assessor ID | p775-0001 |
|------------------|-------------------------------------------------------------------------------------|-------------|-----------|

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

## Building Elements

### Floor Ground Floor - Stoneham - Ground Floor

Floor Type: Suspended Floor

Area = 11.83 m<sup>2</sup>, Perimeter = 18.15 m, Wall thickness = 300.00 mm, Soil: Unknown

Depth of underfloor space below ground: 0.200 m Floor wind shielding: Average (suburban)

Floor height above ground: h = 0.200 m

U-value of walls above ground: U<sub>w</sub> = 1.500 m

Ventilation openings per perimeter length: e = 0.0015 %

Mean wind speed: v = 5.000 m/s

Resistance on solum: R<sub>g</sub> = 0.000 m<sup>2</sup>K/W

| Layer       | Description                                                | Thickness<br>(mm) | Conductivity<br>(W/m <sup>2</sup> K) | Resistance<br>(m <sup>2</sup> K/W) | Fraction<br>(%) |
|-------------|------------------------------------------------------------|-------------------|--------------------------------------|------------------------------------|-----------------|
| Ext surface |                                                            |                   |                                      | 0.1700                             |                 |
| Layer 1     | <b>Blockwork, dense</b>                                    |                   |                                      |                                    |                 |
|             | Main construction                                          | 100               | 1.5900                               | 0.0629                             | 82.95           |
|             | Main construction                                          | 100               | 2.2000                               | 0.0455                             | 17.05           |
| Layer 2     | <b>Jablite Jabfloor (HP)</b>                               |                   |                                      |                                    |                 |
|             | Main construction                                          | 150               | 0.0320                               | 4.6875                             | 100.00          |
|             | Corrections - Air Gap: Level 1, Fasteners: None or plastic |                   |                                      |                                    |                 |
| Layer 3     | <b>Screed</b>                                              |                   |                                      |                                    |                 |
|             | Main construction                                          | 75                | 1.1500                               | 0.0652                             | 100.00          |
| Int surface |                                                            |                   |                                      | 0.1700                             |                 |

Total resistance: Upper limit = 5.153 m<sup>2</sup> K/W Lower limit = 5.152 m<sup>2</sup> K/W Average = 5.152 m<sup>2</sup> K/W

Total correction = 0.0083 m<sup>2</sup> K/W

U-value (unrounded) = 0.18 W/m<sup>2</sup> K

Unheated space: None

Total thickness: 325 mm

U-value: 0.18 W/m<sup>2</sup> K

Kappa: n/a

# U-VALUE CALCULATOR REPORT

|                      |                                                              |                |            |
|----------------------|--------------------------------------------------------------|----------------|------------|
| Property Reference   | SAP-0796 (3B4A) - Plot 209                                   | Issued on Date | 16/03/2023 |
| Assessment Reference | AB                                                           | Prop Type Ref  | FOG 3      |
| Project              | 89 Highwood Avenue, North Stoneham Park, EASTLEIGH, SO50 9QY |                |            |
| Calculation Type     | New Build (As Built)                                         |                |            |

|                                    |      |             |       |      |       |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating                         | 86 B | DER         | 14.92 | TER  | 18.43 |
| Environmental                      | 86 B | % DER<TER   | 19.05 |      |       |
| CO <sub>2</sub> Emissions (t/year) | 1.52 | DFEE        | 50.24 | TFEE | 64.23 |
| General Requirements Compliance    | Pass | % DFEE<TFEE | 21.78 |      |       |

|                  |                                                                                     |             |           |
|------------------|-------------------------------------------------------------------------------------|-------------|-----------|
| Assessor Details | Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920,<br>scott@beatsolutions.co.uk | Assessor ID | p775-0001 |
|------------------|-------------------------------------------------------------------------------------|-------------|-----------|

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

## Building Elements

### Floor Suspended Exposed Floors

#### Floor Type: Exposed Floor

| Layer       | Description                                                   | Thickness<br>(mm) | Conductivity<br>(W/m <sup>2</sup> K) | Resistance<br>(m <sup>2</sup> K/W) | Fraction<br>(%) |
|-------------|---------------------------------------------------------------|-------------------|--------------------------------------|------------------------------------|-----------------|
| Ext surface |                                                               |                   |                                      | 0.0400                             |                 |
| Layer 1     | <b>Chipboard</b>                                              |                   |                                      |                                    |                 |
|             | Main construction                                             | 22                | 0.1300                               | 0.1692                             | 100.00          |
| Layer 2     | <b>Joist Void</b>                                             |                   |                                      |                                    |                 |
|             | Main construction                                             | 35                | 0.1768                               | 0.1980                             | 87.50           |
|             | Main construction                                             | 35                | 0.1300                               | 0.2692                             | 12.50           |
|             | Corrections - Cavity Unventilated, Emissivity:<br>Normal      |                   |                                      |                                    |                 |
| Layer 3     | <b>Mineral wool</b>                                           |                   |                                      |                                    |                 |
|             | Main construction                                             | 200               | 0.0400                               | 5.0000                             | 87.50           |
|             | Main construction                                             | 200               | 0.1300                               | 1.5385                             | 12.50           |
|             | Corrections - Air Gap: Level 1, Fasteners: None or<br>plastic |                   |                                      |                                    |                 |
| Layer 4     | <b>Celotex TB4000</b>                                         |                   |                                      |                                    |                 |
|             | Main construction                                             | 25                | 0.0220                               | 1.1364                             | 100.00          |
|             | Corrections - Air Gap: Level 1, Fasteners: None or<br>plastic |                   |                                      |                                    |                 |
| Layer 5     | <b>airspace/timber battens</b>                                |                   |                                      |                                    |                 |
|             | Main construction                                             | 22                | 0.1222                               | 0.1800                             | 89.63           |
|             | Main construction                                             | 22                | 0.1196                               | 0.1840                             | 10.37           |
|             | Corrections - Cavity Unventilated, Emissivity:<br>Normal      |                   |                                      |                                    |                 |
| Layer 6     | <b>Masterboard</b>                                            |                   |                                      |                                    |                 |
|             | Main construction                                             | 12                | 0.2200                               | 0.0545                             | 100.00          |
| Int surface |                                                               |                   |                                      | 0.1700                             |                 |

|                   |                                              |                                               |                                    |
|-------------------|----------------------------------------------|-----------------------------------------------|------------------------------------|
| Total resistance: | Upper limit = 6.191 m <sup>2</sup> K/W       | Lower limit = 5.858 m <sup>2</sup> K/W        | Average = 6.024 m <sup>2</sup> K/W |
|                   | Total correction = 0.0046 m <sup>2</sup> K/W | U-value (unrounded) = 0.16 W/m <sup>2</sup> K |                                    |

Unheated space: GarageSingle1Outside

Total thickness: 316 mm

U-value: 0.16 W/m<sup>2</sup> K

Kappa: n/a

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

|                                    |                                                                                  |               |       |      |                |            |
|------------------------------------|----------------------------------------------------------------------------------|---------------|-------|------|----------------|------------|
| Property Reference                 | SAP-0796 (3B4A) - Plot 209                                                       |               |       |      | Issued on Date | 16/03/2023 |
| Assessment Reference               | AB                                                                               | Prop Type Ref | FOG 3 |      |                |            |
| Property                           | 89 Highwood Avenue, North Stoneham Park, EASTLEIGH, SO50 9QY                     |               |       |      |                |            |
|                                    |                                                                                  |               |       |      |                |            |
| SAP Rating                         | 86 B                                                                             | DER           | 14.92 | TER  | 18.43          |            |
| Environmental                      | 86 B                                                                             | % DER<TER     | 19.05 |      |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.52                                                                             | DFEE          | 50.24 | TFEE | 64.23          |            |
| General Requirements Compliance    | Pass                                                                             | % DFEE<TFEE   | 21.78 |      |                |            |
|                                    |                                                                                  |               |       |      |                |            |
| 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

End-Terrace Maisonette, total floor area 126 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) 18.43 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.92 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 64.2 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 50.2 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         | 0.16 (max. 0.25) | 0.18 (max. 0.70) | OK |
| Roof          | 0.10 (max. 0.20) | 0.10 (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: 5.18 (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 Heating LOGIC HEAT2 H15

Efficiency: 89.4% SEDBUK2009  
Minimum: 88.0% OK

Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.40 kWh/day  
Permitted by DBSCG 2.27 OK  
Primary pipework insulated: Yes OK

#### 6 Controls

Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: Cylinderstat OK  
Independent timer for DHW OK

Boiler interlock Yes OK

#### 7 Low energy lights

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

#### 8 Mechanical ventilation

Not applicable

#### 9 Summertime temperature

Overheating risk (Southern England): Not significant OK  
Based on:  
Overshading: Average  
Windows facing East: 7.55 m<sup>2</sup>, No overhang  
Windows facing West: 8.53 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  
Photovoltaic array 0.96 kW

# 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                                           | 11.8300 (1b)              | x 2.4000 (2b)                   | = 28.3920 (1b) - (3b)       |
| First floor                                            | 114.2200 (1c)             | x 2.4000 (2c)                   | = 274.1280 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 126.0500                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 302.5200 (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                                               |                 |                      |       |                             | 3 * 10 = 30.0000 (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) = |                 |                      |       |                             | 30.0000 / (5) = 0.0992 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.1800                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3582 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 1 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3313 (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 | 0.4224 | 0.4141 | 0.4058 | 0.3644 | 0.3562 | 0.3147 | 0.3147 | 0.3065 | 0.3313 | 0.3562 | 0.3727 | 0.3893 (22b) |
| Effective ac    | 0.5892 | 0.5858 | 0.5824 | 0.5664 | 0.5634 | 0.5495 | 0.5495 | 0.5470 | 0.5549 | 0.5634 | 0.5695 | 0.5758 (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                                       |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------------------------------------------|
| Solid Doors                                                    |                         |                            | 2.1600                    | 1.4000                        | 3.0240       |                                | (26)                                                |
| Windows (Uw = 1.40)                                            |                         |                            | 16.0800                   | 1.3258                        | 21.3182      |                                | (27)                                                |
| Ground Floor                                                   |                         |                            | 11.8300                   | 0.1800                        | 2.1294       | 75.0000                        | 887.2500 (28a)                                      |
| Suspended Floor                                                |                         |                            | 102.3900                  | 0.1600                        | 16.3824      | 20.0000                        | 2047.8000 (28b)                                     |
| External Wall                                                  | 141.6000                | 18.2400                    | 123.3600                  | 0.2000                        | 24.6720      | 9.0000                         | 1110.2400 (29a)                                     |
| External Roof                                                  | 114.2200                |                            | 114.2200                  | 0.1000                        | 11.4220      | 9.0000                         | 1027.9800 (30)                                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 370.0400                  |                               |              |                                | (31)                                                |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 78.9480      |                                | (33)                                                |
| Party Wall                                                     |                         |                            | 16.3200                   | 0.0000                        | 0.0000       | 20.0000                        | 326.4000 (32)                                       |
| Internal Wall - FF                                             |                         |                            | 152.2800                  |                               |              | 9.0000                         | 1370.5200 (32c)                                     |
| Internal Ceiling                                               |                         |                            | 11.8300                   |                               |              | 18.0000                        | 212.9400 (32e)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 6983.1300 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 55.3997 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 18.4461 (36)                                        |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 97.3941 (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                     | 58.8224  | 58.4766  | 58.1376  | 56.5453  | 56.2473  | 54.8605  | 54.8605  | 54.6037  | 55.3947  | 56.2473  | 56.8500  | 57.4801 (38)  |
| Heat transfer coeff       | 156.2165 | 155.8706 | 155.5316 | 153.9393 | 153.6414 | 152.2546 | 152.2546 | 151.9977 | 152.7888 | 153.6414 | 154.2441 | 154.8742 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 153.9379 (39) |

  

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.2393 | 1.2366 | 1.2339 | 1.2213 | 1.2189 | 1.2079 | 1.2079 | 1.2059 | 1.2121 | 1.2189 | 1.2237 | 1.2287 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.2212 (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                        |  |  |  |  |  |  |  |  |  |  |  | 2.8840 (42)   |
| Average daily hot water use (litres/day) |  |  |  |  |  |  |  |  |  |  |  | 102.6941 (43) |

  

|                                        | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec                               |
|----------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------------------------|
| Daily hot water use                    | 112.9635 | 108.8557 | 104.7479 | 100.6402 | 96.5324  | 92.4247  | 92.4247  | 96.5324  | 100.6402 | 104.7479 | 108.8557 | 112.9635 (44)                     |
| Energy conte                           | 167.5216 | 146.5154 | 151.1908 | 131.8118 | 126.4766 | 109.1397 | 101.1339 | 116.0527 | 117.4387 | 136.8635 | 149.3972 | 162.2357 (45)                     |
| Energy content (annual)                |          |          |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = 1615.7776 (45) |
| Distribution loss (46)m = 0.15 x (45)m |          |          |          |          |          |          |          |          |          |          |          |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

|                                                                 |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| 25.1282                                                         | 21.9773  | 22.6786  | 19.7718  | 18.9715  | 16.3709  | 15.1701  | 17.4079  | 17.6158  | 20.5295  | 22.4096  | 24.3354 (46)  |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          | 205.0000 (47) |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          | 1.4000 (48)   |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          | 0.5400 (49)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          | 0.7560 (55)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |               |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |               |
| 23.4360                                                         | 21.1680  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360 (56)  |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |               |
| 23.4360                                                         | 21.1680  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |               |
| 214.2200                                                        | 188.6946 | 197.8892 | 177.0038 | 173.1750 | 154.3317 | 147.8323 | 162.7511 | 162.6307 | 183.5619 | 194.5892 | 208.9341 (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 (63)   |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)   |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |               |
| 214.2200                                                        | 188.6946 | 197.8892 | 177.0038 | 173.1750 | 154.3317 | 147.8323 | 162.7511 | 162.6307 | 183.5619 | 194.5892 | 208.9341 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |               |
| 93.0596                                                         | 82.4597  | 87.6297  | 79.9810  | 79.4122  | 72.4425  | 70.9858  | 75.9462  | 75.2020  | 82.8658  | 85.8282  | 91.3021 (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                                                                               | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 28.5926   | 25.3957   | 20.6532   | 15.6358   | 11.6879   | 9.8674    | 10.6621   | 13.8590   | 18.6016   | 23.6190   | 27.5668   | 29.3873 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 292.8939  | 295.9332  | 288.2742  | 271.9692  | 251.3869  | 232.0425  | 219.1192  | 216.0799  | 223.7389  | 240.0440  | 260.6262  | 279.9707 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198 (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)                                 |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 (71) |
| Water heating gains (Table 5)                                                       |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 125.0802  | 122.7079  | 117.7818  | 111.0848  | 106.7368  | 100.6146  | 95.4110   | 102.0783  | 104.4472  | 111.3788  | 119.2058  | 122.7179 (72)  |
| Total internal gains                                                                |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 515.8261  | 513.2963  | 495.9686  | 467.9491  | 439.0710  | 411.7840  | 394.4517  | 401.2766  | 416.0471  | 444.3012  | 476.6583  | 501.3352 (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   |          |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|---------------|
| East        |          |          |          |          | 7.5500     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 45.3175 (76) |          |               |
| West        |          |          |          |          | 8.5300     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 51.1998 (80) |          |               |
|             |          |          |          |          |            |                                |                                   |                                    |                              |              |          |               |
| Solar gains | 96.5173  | 188.8083 | 310.9404 | 453.4881 | 555.7666   | 568.9260                       | 541.6408                          | 465.2614                           | 361.6366                     | 224.0370     | 120.3457 | 79.3711 (83)  |
| Total gains | 612.3434 | 702.1046 | 806.9091 | 921.4372 | 994.8377   | 980.7100                       | 936.0925                          | 866.5381                           | 777.6836                     | 668.3381     | 597.0040 | 580.7064 (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                                                                         | 12.4171 | 12.4447 | 12.4718 | 12.6008 | 12.6252 | 12.7402 | 12.7402 | 12.7618 | 12.6957 | 12.6252             | 12.5759 | 12.5247      |
| alpha                                                                       | 1.8278  | 1.8296  | 1.8315  | 1.8401  | 1.8417  | 1.8493  | 1.8493  | 1.8508  | 1.8464  | 1.8417              | 1.8384  | 1.8350       |
| util living area                                                            |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 0.9450  | 0.9280  | 0.8966  | 0.8399  | 0.7573  | 0.6470  | 0.5373  | 0.5780  | 0.7418  | 0.8725              | 0.9293  | 0.9497 (86)  |
| MIT                                                                         |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 17.2576 | 17.5704 | 18.1688 | 18.9748 | 19.7421 | 20.3634 | 20.6873 | 20.6281 | 20.1080 | 19.1101             | 18.0475 | 17.2002 (87) |
| Th 2                                                                        |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 19.8887 | 19.8908 | 19.8930 | 19.9030 | 19.9049 | 19.9137 | 19.9137 | 19.9153 | 19.9103 | 19.9049             | 19.9011 | 19.8971 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 0.9387  | 0.9198  | 0.8842  | 0.8192  | 0.7217  | 0.5853  | 0.4433  | 0.4875  | 0.6907  | 0.8516              | 0.9199  | 0.9440 (89)  |
| MIT 2                                                                       |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 16.4593 | 16.7697 | 17.3616 | 18.1564 | 18.8942 | 19.4735 | 19.7460 | 19.7055 | 19.2551 | 18.3025             | 17.2531 | 16.4077 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             |         |         |         |         |         |         |         |         | fLA =   | Living area / (4) = |         |              |
| MIT                                                                         |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 16.7396 | 17.0508 | 17.6449 | 18.4437 | 19.1919 | 19.7859 | 20.0764 | 20.0294 | 19.5545 | 18.5860             | 17.5320 | 16.6859 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             |         |         |         |         |         |         |         |         |         |                     |         | -0.1500      |
| adjusted MIT                                                                |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 16.5896 | 16.9008 | 17.4949 | 18.2937 | 19.0419 | 19.6359 | 19.9264 | 19.8794 | 19.4045 | 18.4360             | 17.3820 | 16.5359 (93) |

#### 8. Space heating requirement

|                      |           |           |           |           |           |          |          |          |          |           |           |                           |
|----------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|---------------------------|
|                      | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec                       |
| Utilisation          | 0.9122    | 0.8891    | 0.8485    | 0.7807    | 0.6880    | 0.5672   | 0.4445   | 0.4841   | 0.6620   | 0.8147    | 0.8896    | 0.9190 (94)               |
| Useful gains         | 558.5670  | 624.2259  | 684.6390  | 719.3716  | 684.4429  | 556.2180 | 416.1317 | 419.4528 | 514.8183 | 544.5124  | 531.1129  | 533.6458 (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     |           |           |           |           |           |          |          |          |          |           |           |                           |
|                      | 1919.8316 | 1870.5738 | 1710.0589 | 1446.0562 | 1128.0161 | 766.7358 | 506.4666 | 528.8615 | 810.4724 | 1203.9337 | 1585.9317 | 1910.5154 (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    |           |           |           |           |           |          |          |          |          |           |           |                           |
|                      | 1012.7809 | 837.5458  | 762.9124  | 523.2129  | 330.0184  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 490.6095  | 759.4696  | 1024.3910 (98)            |
| Space heating        |           |           |           |           |           |          |          |          |          |           |           |                           |
|                      |           |           |           |           |           |          |          |          |          |           |           | 5740.9405 (98)            |
| Space heating per m2 |           |           |           |           |           |          |          |          |          |           |           |                           |
|                      |           |           |           |           |           |          |          |          |          |           |           | (98) / (4) = 45.5449 (99) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

8c. Space cooling requirement

Not applicable

#### 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 %)                      |           |          |          |          |          |          |          |          |          |           |          |           | 90.4000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |           |          |          |          |          |          |          |          |          |           |          |           | 0.0000 (208)    |
| Space heating requirement                                             |           |          |          |          |          |          |          |          |          |           |          |           | 6350.5979 (211) |
|                                                                       | Jan       | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct       | Nov      | Dec       |                 |
| Space heating requirement                                             | 1012.7809 | 837.5458 | 762.9124 | 523.2129 | 330.0184 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 490.6095  | 759.4696 | 1024.3910 | (98)            |
| Space heating efficiency (main heating system 1)                      | 90.4000   | 90.4000  | 90.4000  | 90.4000  | 90.4000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 90.4000   | 90.4000  | 90.4000   | (210)           |
| Space heating fuel (main heating system)                              | 1120.3329 | 926.4887 | 843.9297 | 578.7753 | 365.0646 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 542.7096  | 840.1212 | 1133.1759 | (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                                             | 214.2200  | 188.6946 | 197.8892 | 177.0038 | 173.1750 | 154.3317 | 147.8323 | 162.7511 | 162.6307 | 183.5619  | 194.5892 | 208.9341  | (64)            |
| Efficiency of water heater (217)m                                     | 88.3296   | 88.2222  | 87.9676  | 87.4328  | 86.4077  | 79.7000  | 79.7000  | 79.7000  | 79.7000  | 87.2120   | 87.9906  | 79.7000   | (216)           |
| Fuel for water heating, kWh/month                                     | 242.5233  | 213.8856 | 224.9569 | 202.4456 | 200.4162 | 193.6407 | 185.4860 | 204.2046 | 204.0536 | 210.4777  | 221.1477 | 236.3783  | (219)           |
| Water heating fuel used                                               |           |          |          |          |          |          |          |          |          |           |          | 2539.6163 | (219)           |
| Annual totals kWh/year                                                |           |          |          |          |          |          |          |          |          |           |          |           |                 |
| Space heating fuel - main system                                      |           |          |          |          |          |          |          |          |          |           |          | 6350.5979 | (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)                   |           |          |          |          |          |          |          |          |          |           |          | 504.9545  | (232)           |
| Energy saving/generation technologies (Appendices M ,N and Q)         |           |          |          |          |          |          |          |          |          |           |          |           |                 |
| PV Unit 0 (0.80 * 0.96 * 853 * 1.00) =                                |           |          |          |          |          |          |          |          |          | -655.1270 |          | -655.1270 | (233)           |
| Total delivered energy for all uses                                   |           |          |          |          |          |          |          |          |          |           |          | 8815.0417 | (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               | 6350.5979          | 0.2160                        | 1371.7291 (261)          |
| Space heating - secondary                   | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                  | 2539.6163          | 0.2160                        | 548.5571 (264)           |
| Space and water heating                     |                    |                               | 1920.2863 (265)          |
| Pumps and fans                              | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                         | 504.9545           | 0.5190                        | 262.0714 (268)           |
| Energy saving/generation technologies       |                    |                               |                          |
| PV Unit                                     | -655.1270          | 0.5190                        | -340.0109 (269)          |
| Total CO2, kg/year                          |                    |                               | 1881.2717 (272)          |
| Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 14.9200 (273)            |

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

|                                                                                 |  |     |             |
|---------------------------------------------------------------------------------|--|-----|-------------|
| DER                                                                             |  |     | 14.9200 ZC1 |
| Total Floor Area                                                                |  | TFA | 126.0500    |
| Assumed number of occupants                                                     |  | N   | 2.8840      |
| CO2 emission factor in Table 12 for electricity displaced from grid             |  | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |  |     | 13.7694 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |  |     | 1.4932 ZC3  |
| Total CO2 emissions                                                             |  |     | 30.1825 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                                                               |  |     | 30.1825 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                                           | 11.8300 (1b)              | x 2.4000 (2b)                   | = 28.3920 (1b) - (3b)       |
| First floor                                            | 114.2200 (1c)             | x 2.4000 (2c)                   | = 274.1280 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 126.0500                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 302.5200 (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                                             |                 |                      |       |                             | 4 * 10 = 40.0000 (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) |                 |                      |       |                             | 40.0000 / (5) = 0.1322 (8) |
| Pressure test                                                           |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                    |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                       |                 |                      |       |                             | 0.3822 (18)                |
| Number of sides sheltered                                               |                 |                      |       |                             | 1 (19)                     |
| Shelter factor                                                          |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor                    |                 |                      |       | (21) = (18) x (20) =        | 0.3536 (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 | 0.4508 | 0.4419 | 0.4331 | 0.3889 | 0.3801 | 0.3359 | 0.3359 | 0.3270 | 0.3536 | 0.3801 | 0.3978 | 0.4154 (22b) |
| Effective ac    | 0.6016 | 0.5977 | 0.5938 | 0.5756 | 0.5722 | 0.5564 | 0.5564 | 0.5535 | 0.5625 | 0.5722 | 0.5791 | 0.5863 (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 Opaque door                                                |                         |                            | 2.1600                    | 1.0000                        | 2.1600       |                                | (26)          |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 16.0800                   | 1.3258                        | 21.3182      |                                | (27)          |
| Ground Floor                                                   |                         |                            | 11.8300                   | 0.1300                        | 1.5379       |                                | (28a)         |
| Suspended Floor                                                |                         |                            | 102.3900                  | 0.1300                        | 13.3107      |                                | (28b)         |
| External Wall                                                  | 141.6000                | 18.2400                    | 123.3600                  | 0.1800                        | 22.2048      |                                | (29a)         |
| External Roof                                                  | 114.2200                |                            | 114.2200                  | 0.1300                        | 14.8486      |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 370.0400                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 75.3802      |                                | (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)     |                         |                            |                           |                               |              |                                | 19.2166 (36)  |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 94.5968 (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                     | 60.0590  | 59.6651  | 59.2790  | 57.4657  | 57.1264  | 55.5470  | 55.5470  | 55.2545  | 56.1554  | 57.1264  | 57.8128  | 58.5303 (38)  |
| Heat transfer coeff       | 154.6558 | 154.2619 | 153.8758 | 152.0625 | 151.7232 | 150.1438 | 150.1438 | 149.8513 | 150.7521 | 151.7232 | 152.4095 | 153.1271 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 152.0608 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.2269 | 1.2238 | 1.2208 | 1.2064 | 1.2037 | 1.1911 | 1.1911 | 1.1888 | 1.1960 | 1.2037 | 1.2091 | 1.2148 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.2064 (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                                           |          |          |          |          |          |          |          |          |          |                    |          | 2.8840 (42)    |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------------|----------|----------------|
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |          |          |          |                    |          | 102.6941 (43)  |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct                | Nov      | Dec            |
| Daily hot water use                                         | 112.9635 | 108.8557 | 104.7479 | 100.6402 | 96.5324  | 92.4247  | 92.4247  | 96.5324  | 100.6402 | 104.7479           | 108.8557 | 112.9635 (44)  |
| Energy conte                                                | 167.5216 | 146.5154 | 151.1908 | 131.8118 | 126.4766 | 109.1397 | 101.1339 | 116.0527 | 117.4387 | 136.8635           | 149.3972 | 162.2357 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = |          | 1615.7776 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 25.1282  | 21.9773  | 22.6786  | 19.7718  | 18.9715  | 16.3709  | 15.1701  | 17.4079  | 17.6158  | 20.5295            | 22.4096  | 24.3354 (46)   |
| Water storage loss:                                         |          |          |          |          |          |          |          |          |          |                    |          | 205.0000 (47)  |
| Store volume                                                |          |          |          |          |          |          |          |          |          |                    |          | 1.6772 (48)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |          |          |          |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.5400 (49)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.9057 (55)   |
| Total storage loss                                              | 28.0756  | 25.3586  | 28.0756  | 27.1699  | 28.0756  | 27.1699  | 28.0756  | 28.0756  | 27.1699  | 28.0756  | 27.1699  | 28.0756 (56)  |
| If cylinder contains dedicated solar storage                    | 28.0756  | 25.3586  | 28.0756  | 27.1699  | 28.0756  | 27.1699  | 28.0756  | 28.0756  | 27.1699  | 28.0756  | 27.1699  | 28.0756 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 218.8596 | 192.8852 | 202.5288 | 181.4937 | 177.8146 | 158.8216 | 152.4719 | 167.3907 | 167.1206 | 188.2015 | 199.0791 | 213.5737 (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                                                 | 218.8596 | 192.8852 | 202.5288 | 181.4937 | 177.8146 | 158.8216 | 152.4719 | 167.3907 | 167.1206 | 188.2015 | 199.0791 | 213.5737 (64) |
| Heat gains from water heating, kWh/month                        | 96.7713  | 85.8122  | 91.3413  | 83.5730  | 83.1239  | 76.0345  | 74.6974  | 79.6579  | 78.7939  | 86.5775  | 89.4201  | 95.0138 (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                                                                               | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 28.5926   | 25.3957   | 20.6532   | 15.6358   | 11.6879   | 9.8674    | 10.6621   | 13.8590   | 18.6016   | 23.6190   | 27.5668   | 29.3873   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 292.8939  | 295.9332  | 288.2742  | 271.9692  | 251.3869  | 232.0425  | 219.1192  | 216.0799  | 223.7389  | 240.0440  | 260.6262  | 279.9707  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | (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)                                 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | (71) |
| Water heating gains (Table 5)                                                       | 130.0690  | 127.6968  | 122.7706  | 116.0736  | 111.7256  | 105.6035  | 100.3998  | 107.0671  | 109.4360  | 116.3676  | 124.1946  | 127.7067  | (72) |
| Total internal gains                                                                | 520.8149  | 518.2851  | 500.9575  | 472.9379  | 444.0599  | 416.7728  | 399.4405  | 406.2654  | 421.0359  | 449.2900  | 481.6471  | 506.3240  | (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    |              |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|--------|--|---------------|--------------|
| East        |          |          |          |          | 7.5500     | 19.6403                        | 0.6300                            |                                    | 0.7000   |          |                              | 0.7700 |  |               | 45.3175 (76) |
| West        |          |          |          |          | 8.5300     | 19.6403                        | 0.6300                            |                                    | 0.7000   |          |                              | 0.7700 |  |               | 51.1998 (80) |
| -----       |          |          |          |          |            |                                |                                   |                                    |          |          |                              |        |  |               |              |
| Solar gains | 96.5173  | 188.8083 | 310.9404 | 453.4881 | 555.7666   | 568.9260                       | 541.6408                          | 465.2614                           | 361.6366 | 224.0370 | 120.3457                     |        |  | 79.3711 (83)  |              |
| Total gains | 617.3322 | 707.0934 | 811.8979 | 926.4260 | 999.8265   | 985.6988                       | 941.0813                          | 871.5269                           | 782.6724 | 673.3270 | 601.9928                     |        |  | 585.6952 (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                                                                         | 56.5997 | 56.7442 | 56.8866 | 57.5650 | 57.6937 | 58.3006 | 58.3006 | 58.4144 | 58.0653                   | 57.6937 | 57.4339 | 57.1648      |
| alpha                                                                       | 4.7733  | 4.7829  | 4.7924  | 4.8377  | 4.8462  | 4.8867  | 4.8867  | 4.8943  | 4.8710                    | 4.8462  | 4.8289  | 4.8110       |
| util living area                                                            | 0.9992  | 0.9982  | 0.9950  | 0.9817  | 0.9367  | 0.8194  | 0.6596  | 0.7209  | 0.9237                    | 0.9907  | 0.9984  | 0.9994 (86)  |
| MIT                                                                         | 19.5555 | 19.6930 | 19.9530 | 20.3138 | 20.6499 | 20.8867 | 20.9705 | 20.9548 | 20.7656                   | 20.3279 | 19.8814 | 19.5367 (87) |
| Th 2                                                                        | 19.8985 | 19.9010 | 19.9034 | 19.9149 | 19.9171 | 19.9271 | 19.9271 | 19.9290 | 19.9232                   | 19.9171 | 19.9127 | 19.9082 (88) |
| util rest of house                                                          | 0.9989  | 0.9976  | 0.9930  | 0.9737  | 0.9062  | 0.7336  | 0.5193  | 0.5849  | 0.8735                    | 0.9854  | 0.9976  | 0.9992 (89)  |
| MIT 2                                                                       | 17.9660 | 18.1688 | 18.5500 | 19.0801 | 19.5489 | 19.8439 | 19.9153 | 19.9083 | 19.7131                   | 19.1064 | 18.4528 | 17.9451 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3511 (91)  |
| MIT                                                                         | 18.5240 | 18.7039 | 19.0425 | 19.5132 | 19.9354 | 20.2100 | 20.2857 | 20.2757 | 20.0826                   | 19.5352 | 18.9543 | 18.5038 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.5240 | 18.7039 | 19.0425 | 19.5132 | 19.9354 | 20.2100 | 20.2857 | 20.2757 | 20.0826                   | 19.5352 | 18.9543 | 18.5038 (93) |

#### 8. Space heating requirement

|                      |           |           |           |           |           |          |          |          |          |           |           |              |              |
|----------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|--------------|--------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec          |              |
| Useful gains         | 0.9983    | 0.9966    | 0.9908    | 0.9698    | 0.9069    | 0.7590   | 0.5691   | 0.6328   | 0.8827   | 0.9828    | 0.9967    | 0.9987       | (94)         |
| Ext temp.            | 616.3006  | 704.6670  | 804.4316  | 898.4119  | 906.7058  | 748.1521 | 535.5852 | 551.5268 | 690.8804 | 661.7266  | 600.0000  | 584.9421     | (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         | 2199.8177 | 2129.4111 | 1929.9889 | 1613.8622 | 1249.5033 | 842.3058 | 553.3900 | 580.7796 | 901.8869 | 1355.6815 | 1806.7124 | 2190.3008    | (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        | 1178.1367 | 957.4280  | 837.4146  | 515.1242  | 255.0414  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 516.3024  | 868.8330  | 1194.3869    | (98)         |
| Space heating per m2 |           |           |           |           |           |          |          |          |          |           |           | 6322.6673    | (98)         |
|                      |           |           |           |           |           |          |          |          |          |           |           | (98) / (4) = | 50.1600 (99) |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF TARGET EMISSIONS 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 %)                      |           |           |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |           |           |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |           |           |          |          |          |          |          |          |          |          |          |           | 6762.2110 (211) |
|                                                                       | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 1178.1367 | 957.4280  | 837.4146 | 515.1242 | 255.0414 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 516.3024 | 868.8330 | 1194.3869 | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000   | 93.5000   | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 1260.0392 | 1023.9871 | 895.6306 | 550.9350 | 272.7715 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 552.1951 | 929.2331 | 1277.4192 | (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                                             | 218.8596  | 192.8852  | 202.5288 | 181.4937 | 177.8146 | 158.8216 | 152.4719 | 167.3907 | 167.1206 | 188.2015 | 199.0791 | 213.5737  | (64)            |
| Efficiency of water heater (217)m                                     | 88.6380   | 88.5100   | 88.1969  | 87.4452  | 85.7754  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 87.3704  | 88.2930  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 246.9138  | 217.9248  | 229.6325 | 207.5514 | 207.3026 | 199.0246 | 191.0676 | 209.7627 | 209.4244 | 215.4064 | 225.4755 | 240.7930  | (219)           |
| Water heating fuel used                                               |           |           |          |          |          |          |          |          |          |          |          | 2600.2794 | (219)           |
| Annual totals kWh/year                                                |           |           |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |           |           |          |          |          |          |          |          |          |          |          | 6762.2110 | (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)                   |           |           |          |          |          |          |          |          |          |          |          | 504.9545  | (232)           |
| Total delivered energy for all uses                                   |           |           |          |          |          |          |          |          |          |          |          | 9942.4448 | (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                                                                     | 6762.2110          | 0.2160                        | 1460.6376 (261)          |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2600.2794          | 0.2160                        | 561.6603 (264)           |
| Space and water heating                                                                           |                    |                               | 2022.2979 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 504.9545           | 0.5190                        | 262.0714 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 2323.2943 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 16.0436 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.0791 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.3088 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (16.0436 * 1.00) + 2.0791 + 0.3088, rounded to 2 d.p. |                    |                               | 18.4300 (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                                           | 11.8300 (1b)              | x 2.4000 (2b)                   | = 28.3920 (1b) - (3b)       |
| First floor                                            | 114.2200 (1c)             | x 2.4000 (2c)                   | = 274.1280 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 126.0500                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 302.5200 (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                                             |                 |                      |       |                             | 4 * 10 = 40.0000 (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) |                 |                      |       |                             | 40.0000 / (5) = 0.1322 (8) |
| Pressure test                                                           |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                    |                 |                      |       |                             | 5.1800                     |
| Infiltration rate                                                       |                 |                      |       |                             | 0.3912 (18)                |
| Number of sides sheltered                                               |                 |                      |       |                             | 1 (19)                     |
| Shelter factor                                                          |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor                    |                 |                      |       | (21) = (18) x (20) =        | 0.3619 (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 | 0.4614 | 0.4524 | 0.4433 | 0.3981 | 0.3890 | 0.3438 | 0.3438 | 0.3347 | 0.3619 | 0.3890 | 0.4071 | 0.4252 (22b) |
| Effective ac    | 0.6064 | 0.6023 | 0.5983 | 0.5792 | 0.5757 | 0.5591 | 0.5591 | 0.5560 | 0.5655 | 0.5757 | 0.5829 | 0.5904 (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   |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| Solid Doors                                                 |                         |                            | 2.1600                    | 1.4000                        | 3.0240       |                                | (26)            |
| Windows (Uw = 1.40)                                         |                         |                            | 16.0800                   | 1.3258                        | 21.3182      |                                | (27)            |
| Ground Floor                                                |                         |                            | 11.8300                   | 0.1800                        | 2.1294       | 75.0000                        | 887.2500 (28a)  |
| Suspended Floor                                             |                         |                            | 102.3900                  | 0.1600                        | 16.3824      | 20.0000                        | 2047.8000 (28b) |
| External Wall                                               | 141.6000                | 18.2400                    | 123.3600                  | 0.2000                        | 24.6720      | 9.0000                         | 1110.2400 (29a) |
| External Roof                                               | 114.2200                |                            | 114.2200                  | 0.1000                        | 11.4220      | 9.0000                         | 1027.9800 (30)  |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 370.0400                  |                               |              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           | (26)...(30) + (32) =          | 78.9480      |                                | (33)            |
| Party Wall                                                  |                         |                            | 16.3200                   | 0.0000                        | 0.0000       | 20.0000                        | 326.4000 (32)   |
| Internal Wall - FF                                          |                         |                            | 152.2800                  |                               |              | 9.0000                         | 1370.5200 (32c) |
| Internal Ceiling                                            |                         |                            | 11.8300                   |                               |              | 9.0000                         | 106.4700 (32e)  |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 6876.6600 (34)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 54.5550 (35)  
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 18.4461 (36)  
Total fabric heat loss (33) + (36) = 97.3941 (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                                                               | 60.5423    | 60.1297    | 59.7252    | 57.8254    | 57.4700    | 55.8153    | 55.8153    | 55.5089    | 56.4527    | 57.4700    | 58.1890    | 58.9408 (38)    |
| Heat transfer coeff                                                 | 157.9364   | 157.5237   | 157.1192   | 155.2195   | 154.8640   | 153.2094   | 153.2094   | 152.9030   | 153.8467   | 154.8640   | 155.5831   | 156.3348 (39)   |
| Average = Sum(39)m / 12 =                                           |            |            |            |            |            |            |            |            |            |            |            | 155.2178 (39)   |
| HLP                                                                 | Jan 1.2530 | Feb 1.2497 | Mar 1.2465 | Apr 1.2314 | May 1.2286 | Jun 1.2155 | Jul 1.2155 | Aug 1.2130 | Sep 1.2205 | Oct 1.2286 | Nov 1.2343 | Dec 1.2403 (40) |
| HLP (average)                                                       |            |            |            |            |            |            |            |            |            |            |            | 1.2314 (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                        |              |              |              |              |             |             |             |             |              |                    |              | 2.8840 (42)       |
| Average daily hot water use (litres/day) |              |              |              |              |             |             |             |             |              |                    |              | 102.6941 (43)     |
| Daily hot water use                      | Jan 112.9635 | Feb 108.8557 | Mar 104.7479 | Apr 100.6402 | May 96.5324 | Jun 92.4247 | Jul 92.4247 | Aug 96.5324 | Sep 100.6402 | Oct 104.7479       | Nov 108.8557 | Dec 112.9635 (44) |
| Energy conte                             | 167.5216     | 146.5154     | 151.1908     | 131.8118     | 126.4766    | 109.1397    | 101.1339    | 116.0527    | 117.4387     | 136.8635           | 149.3972     | 162.2357 (45)     |
| Energy content (annual)                  |              |              |              |              |             |             |             |             |              | Total = Sum(45)m = |              | 1615.7776 (45)    |
| Distribution loss (46)m = 0.15 x (45)m   |              |              |              |              |             |             |             |             |              |                    |              |                   |

# 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  | 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  | (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  | (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  | (59)         |
| Heat gains from water heating, kWh/month     | 35.5983 | 31.1345 | 32.1280 | 28.0100 | 26.8763 | 23.1922 | 21.4910 | 24.6612 | 24.9557 | 29.0835 | 31.7469 | 34.4751 (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                                                                               | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 28.5926   | 25.3957   | 20.6532   | 15.6358   | 11.6879   | 9.8674    | 10.6621   | 13.8590   | 18.6016   | 23.6190   | 27.5668   | 29.3873   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 292.8939  | 295.9332  | 288.2742  | 271.9692  | 251.3869  | 232.0425  | 219.1192  | 216.0799  | 223.7389  | 240.0440  | 260.6262  | 279.9707  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | (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)                                 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | (71) |
| Water heating gains (Table 5)                                                       | 47.8472   | 46.3311   | 43.1829   | 38.9028   | 36.1240   | 32.2114   | 28.8857   | 33.1468   | 34.6607   | 39.0907   | 44.0929   | 46.3375   | (72) |
| Total internal gains                                                                | 435.5932  | 433.9195  | 418.3697  | 392.7671  | 365.4583  | 340.3807  | 324.9265  | 329.3451  | 343.2606  | 369.0131  | 398.5454  | 421.9548  | (73) |

#### 6. Solar gains

|       |            |                                |                              |                              |                              |              |
|-------|------------|--------------------------------|------------------------------|------------------------------|------------------------------|--------------|
| [Jan] | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | Specific data<br>or Table 6b | Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
| East  | 7.5500     | 19.6403                        | 0.6300                       | 0.7000                       | 0.7700                       | 45.3175 (76) |
| West  | 8.5300     | 19.6403                        | 0.6300                       | 0.7000                       | 0.7700                       | 51.1998 (80) |

|             |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Solar gains | 96.5173  | 188.8083 | 310.9404 | 453.4881 | 555.7666 | 568.9260 | 541.6408 | 465.2614 | 361.6366 | 224.0370 | 120.3457 | 79.3711  | (83) |
| Total gains | 532.1105 | 622.7278 | 729.3101 | 846.2552 | 921.2249 | 909.3067 | 866.5673 | 794.6066 | 704.8972 | 593.0501 | 518.8911 | 501.3260 | (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                                                                         | 12.0946 | 12.1263 | 12.1575 | 12.3063 | 12.3346 | 12.4678 | 12.4678 | 12.4928 | 12.4161                   | 12.3346 | 12.2776 | 12.2185 |              |
| alpha                                                                       | 1.8063  | 1.8084  | 1.8105  | 1.8204  | 1.8223  | 1.8312  | 1.8312  | 1.8329  | 1.8277                    | 1.8223  | 1.8185  | 1.8146  |              |
| util living area                                                            | 0.9552  | 0.9393  | 0.9099  | 0.8561  | 0.7773  | 0.6709  | 0.5636  | 0.6070  | 0.7682                    | 0.8912  | 0.9423  | 0.9595  | (86)         |
| MIT                                                                         | 17.0792 | 17.4011 | 18.0171 | 18.8524 | 19.6500 | 20.3047 | 20.6514 | 20.5846 | 20.0266                   | 18.9829 | 17.8890 | 17.0241 | (87)         |
| Th 2                                                                        | 19.8779 | 19.8805 | 19.8830 | 19.8950 | 19.8972 | 19.9076 | 19.9076 | 19.9096 | 19.9036                   | 19.8972 | 19.8927 | 19.8879 | (88)         |
| util rest of house                                                          | 0.9500  | 0.9322  | 0.8988  | 0.8368  | 0.7432  | 0.6102  | 0.4684  | 0.5162  | 0.7197                    | 0.8728  | 0.9344  | 0.9549  | (89)         |
| MIT 2                                                                       | 16.2783 | 16.5987 | 17.2094 | 18.0363 | 18.8070 | 19.4228 | 19.7184 | 19.6720 | 19.1819                   | 18.1781 | 17.0943 | 16.2299 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3511  | (91)         |
| MIT                                                                         | 16.5595 | 16.8804 | 17.4929 | 18.3228 | 19.1029 | 19.7324 | 20.0459 | 19.9924 | 19.4784                   | 18.4606 | 17.3733 | 16.5087 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 16.5595 | 16.8804 | 17.4929 | 18.3228 | 19.1029 | 19.7324 | 20.0459 | 19.9924 | 19.4784                   | 18.4606 | 17.3733 | 16.5087 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |           |          |          |          |          |           |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|-----------|-------|
|                      | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec       |       |
| Utilisation          | 0.9277    | 0.9056    | 0.8669    | 0.8021    | 0.7137    | 0.5990   | 0.4818   | 0.5240   | 0.6968   | 0.8408    | 0.9089    | 0.9341    | (94)  |
| Useful gains         | 493.6575  | 563.9333  | 632.2462  | 678.7485  | 657.4669  | 544.6850 | 417.5491 | 416.4053 | 491.1901 | 498.6218  | 471.6067  | 468.2865  | (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     | 1936.2131 | 1887.2020 | 1727.2014 | 1462.6030 | 1146.4442 | 786.3347 | 527.9458 | 549.2889 | 827.4503 | 1217.3216 | 1598.3444 | 1924.2840 | (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    | 1073.2613 | 889.2365  | 814.6467  | 564.3752  | 363.7991  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 534.7127  | 811.2511  | 1083.2621 | (98)  |
| Space heating        |           |           |           |           |           |          |          |          |          |           |           | 6134.5447 | (98)  |
| Space heating per m2 |           |           |           |           |           |          |          |          |          |           |           | 48.6676   | (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  | 1440.1682 | 1133.7494 | 1162.0625 | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (100) |
| Utilisation                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.5813    | 0.6453    | 0.6128    | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (101) |
| Useful loss                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 837.1422  | 731.6089  | 712.1481  | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (102) |
| Total gains                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1181.0575 | 1128.5382 | 1046.9807 | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (103) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                          |        |        |        |        |        |          |          |          |                          |        |        |                |
|------------------------------------------|--------|--------|--------|--------|--------|----------|----------|----------|--------------------------|--------|--------|----------------|
| Month fraction                           | 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 | 247.6190 | 295.3154 | 249.1154 | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (104)   |
| Space cooling                            |        |        |        |        |        |          |          |          |                          |        |        | 792.0498 (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 | 61.9047  | 73.8289  | 62.2789  | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (107)   |
| Space cooling                            |        |        |        |        |        |          |          |          |                          |        |        | 198.0125 (107) |
| Space cooling per m2                     |        |        |        |        |        |          |          |          |                          |        |        | 1.5709 (108)   |
| Energy for space heating                 |        |        |        |        |        |          |          |          |                          |        |        | 48.6676 (99)   |
| Energy for space cooling                 |        |        |        |        |        |          |          |          |                          |        |        | 1.5709 (108)   |
| Total                                    |        |        |        |        |        |          |          |          |                          |        |        | 50.2385 (109)  |
| Dwelling Fabric Energy Efficiency (DFEE) |        |        |        |        |        |          |          |          |                          |        |        | 50.2 (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                                           | 11.8300 (1b)              | x 2.4000 (2b)        | = 28.3920 (1b) - (3b)                          |
| First floor                                            | 114.2200 (1c)             | x 2.4000 (2c)        | = 274.1280 (1c) - (3c)                         |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 126.0500                  |                      | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 302.5200 (5) |
| Dwelling volume                                        |                           |                      |                                                |

#### 2. Ventilation rate

|                                                      |        |        |        |        |        |        |        |        |        | main                         | secondary | other  | total | m3 per hour |             |          |              |
|------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------------------------|-----------|--------|-------|-------------|-------------|----------|--------------|
|                                                      |        |        |        |        |        |        |        |        |        | heating                      | heating   |        |       |             |             |          |              |
| 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                          |        |        |        |        |        |        |        |        |        |                              |           |        |       |             |             | 4 * 10 = | 40.0000 (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) = |           |        |       |             | 40.0000     | / (5) =  | 0.1322 (8)   |
| Pressure test                                        |        |        |        |        |        |        |        |        |        | Yes                          |           |        |       |             |             |          |              |
| Measured/design AP50                                 |        |        |        |        |        |        |        |        |        | 5.0000                       |           |        |       |             |             |          |              |
| Infiltration rate                                    |        |        |        |        |        |        |        |        |        | 0.3822 (18)                  |           |        |       |             |             |          |              |
| Number of sides sheltered                            |        |        |        |        |        |        |        |        |        | 1 (19)                       |           |        |       |             |             |          |              |
| Shelter factor                                       |        |        |        |        |        |        |        |        |        | (20) = 1 - [0.075 x (19)] =  |           |        |       |             | 0.9250 (20) |          |              |
| Infiltration rate adjusted to include shelter factor |        |        |        |        |        |        |        |        |        | (21) = (18) x (20) =         |           |        |       |             | 0.3536 (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                                      | 0.4508 | 0.4419 | 0.4331 | 0.3889 | 0.3801 | 0.3359 | 0.3359 | 0.3270 | 0.3536 | 0.3801                       | 0.3978    | 0.4154 | (22b) |             |             |          |              |
| Effective ac                                         | 0.6016 | 0.5977 | 0.5938 | 0.5756 | 0.5722 | 0.5564 | 0.5564 | 0.5535 | 0.5625 | 0.5722                       | 0.5791    | 0.5863 | (25)  |             |             |          |              |

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

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K | A x U<br>W/K                 | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------|------------------|------------------------------|-------------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| TER Opaque door                                                     |                |                | 2.1600         | 1.0000           | 2.1600                       |                   | (26)           |                |                |                |                |                     |
| TER Opening Type (Uw = 1.40)                                        |                |                | 16.0800        | 1.3258           | 21.3182                      |                   | (27)           |                |                |                |                |                     |
| Ground Floor                                                        |                |                | 11.8300        | 0.1300           | 1.5379                       |                   | (28a)          |                |                |                |                |                     |
| Suspended Floor                                                     |                |                | 102.3900       | 0.1300           | 13.3107                      |                   | (28b)          |                |                |                |                |                     |
| External Wall                                                       | 141.6000       | 18.2400        | 123.3600       | 0.1800           | 22.2048                      |                   | (29a)          |                |                |                |                |                     |
| External Roof                                                       | 114.2200       |                | 114.2200       | 0.1300           | 14.8486                      |                   | (30)           |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 370.0400       |                  |                              |                   | (31)           |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                |                  | (26)...(30) + (32) = 75.3802 |                   | (33)           |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                  |                              |                   | 250.0000 (35)  |                |                |                |                |                     |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                  |                              |                   | 19.2166 (36)   |                |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                |                  |                              | (33) + (36) =     | 94.5968 (37)   |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                  |                              |                   |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>60.0590 | Feb<br>59.6651 | Mar<br>59.2790 | Apr<br>57.4657   | May<br>57.1264               | Jun<br>55.5470    | Jul<br>55.5470 | Aug<br>55.2545 | Sep<br>56.1554 | Oct<br>57.1264 | Nov<br>57.8128 | Dec<br>58.5303 (38) |
| Heat transfer coeff                                                 | 154.6558       | 154.2619       | 153.8758       | 152.0625         | 151.7232                     | 150.1438          | 150.1438       | 149.8513       | 150.7521       | 151.7232       | 152.4095       | 153.1271 (39)       |
| Average = Sum(39)m / 12 =                                           |                |                |                |                  |                              |                   |                |                |                |                |                | 152.0608 (39)       |
| HLP                                                                 | Jan<br>1.2269  | Feb<br>1.2238  | Mar<br>1.2208  | Apr<br>1.2064    | May<br>1.2037                | Jun<br>1.1911     | Jul<br>1.1911  | Aug<br>1.1888  | Sep<br>1.1960  | Oct<br>1.2037  | Nov<br>1.2091  | Dec<br>1.2148 (40)  |
| HLP (average)                                                       |                |                |                |                  |                              |                   |                |                |                |                |                | 1.2064 (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                        |              |              |              |              |             |             |             |             |              |                    |              | 2.8840 (42)       |
| Average daily hot water use (litres/day) |              |              |              |              |             |             |             |             |              |                    |              | 102.6941 (43)     |
| Daily hot water use                      | Jan 112.9635 | Feb 108.8557 | Mar 104.7479 | Apr 100.6402 | May 96.5324 | Jun 92.4247 | Jul 92.4247 | Aug 96.5324 | Sep 100.6402 | Oct 104.7479       | Nov 108.8557 | Dec 112.9635 (44) |
| Energy conte                             | 167.5216     | 146.5154     | 151.1908     | 131.8118     | 126.4766    | 109.1397    | 101.1339    | 116.0527    | 117.4387     | 136.8635           | 149.3972     | 162.2357 (45)     |
| Energy content (annual)                  |              |              |              |              |             |             |             |             |              | Total = Sum(45)m = |              | 1615.7776 (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)       |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

|                                              |         |         |         |         |         |         |         |         |         |         |         |      |
|----------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| 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  | (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  | (59) |
| Heat gains from water heating, kWh/month     | 35.5983 | 31.1345 | 32.1280 | 28.0100 | 26.8763 | 23.1922 | 21.4910 | 24.6612 | 24.9557 | 29.0835 | 31.7469 | (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                                                                               | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | 144.1980  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 28.5926   | 25.3957   | 20.6532   | 15.6358   | 11.6879   | 9.8674    | 10.6621   | 13.8590   | 18.6016   | 23.6190   | 27.5668   | 29.3873   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 292.8939  | 295.9332  | 288.2742  | 271.9692  | 251.3869  | 232.0425  | 219.1192  | 216.0799  | 223.7389  | 240.0440  | 260.6262  | 279.9707  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | 37.4198   | (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)                                 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | (71) |
| Water heating gains (Table 5)                                                       | 47.8472   | 46.3311   | 43.1829   | 38.9028   | 36.1240   | 32.2114   | 28.8857   | 33.1468   | 34.6607   | 39.0907   | 44.0929   | 46.3375   | (72) |
| Total internal gains                                                                | 435.5932  | 433.9195  | 418.3697  | 392.7671  | 365.4583  | 340.3807  | 324.9265  | 329.3451  | 343.2606  | 369.0131  | 398.5454  | 421.9548  | (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   |          |          |      |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|------|
| East        |          |          |          |          | 7.5500     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 45.3175 (76) |          |          |      |
| West        |          |          |          |          | 8.5300     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 51.1998 (80) |          |          |      |
| -----       |          |          |          |          |            |                                |                                   |                                    |                              |              |          |          |      |
| Solar gains | 96.5173  | 188.8083 | 310.9404 | 453.4881 | 555.7666   | 568.9260                       | 541.6408                          | 465.2614                           | 361.6366                     | 224.0370     | 120.3457 | 79.3711  | (83) |
| Total gains | 532.1105 | 622.7278 | 729.3101 | 846.2552 | 921.2249   | 909.3067                       | 866.5673                          | 794.6066                           | 704.8972                     | 593.0501     | 518.8911 | 501.3260 | (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                                                                         | 56.5997 | 56.7442 | 56.8866 | 57.5650 | 57.6937 | 58.3006 | 58.3006 | 58.4144 | 58.0653                   | 57.6937 | 57.4339 | 57.1648 |         |      |
| alpha                                                                       | 4.7733  | 4.7829  | 4.7924  | 4.8377  | 4.8462  | 4.8867  | 4.8867  | 4.8943  | 4.8710                    | 4.8462  | 4.8289  | 4.8110  |         |      |
| util living area                                                            | 0.9996  | 0.9990  | 0.9968  | 0.9873  | 0.9521  | 0.8522  | 0.7020  | 0.7665  | 0.9461                    | 0.9945  | 0.9992  | 0.9997  | (86)    |      |
| MIT                                                                         | 19.4931 | 19.6314 | 19.8935 | 20.2592 | 20.6060 | 20.8624 | 20.9613 | 20.9406 | 20.7242                   | 20.2709 | 19.8206 | 19.4747 | (87)    |      |
| Th 2                                                                        | 19.8985 | 19.9010 | 19.9034 | 19.9149 | 19.9171 | 19.9271 | 19.9271 | 19.9290 | 19.9232                   | 19.9171 | 19.9127 | 19.9082 | (88)    |      |
| util rest of house                                                          | 0.9994  | 0.9986  | 0.9956  | 0.9815  | 0.9274  | 0.7729  | 0.5592  | 0.6321  | 0.9066                    | 0.9913  | 0.9988  | 0.9996  | (89)    |      |
| MIT 2                                                                       | 18.5167 | 18.6569 | 18.9204 | 19.2922 | 19.6275 | 19.8553 | 19.9161 | 19.9093 | 19.7468                   | 19.3078 | 18.8553 | 18.5059 | (90)    |      |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3511  | (91)    |      |
| MIT                                                                         | 18.8595 | 18.9990 | 19.2620 | 19.6316 | 19.9710 | 20.2089 | 20.2830 | 20.2714 | 20.0899                   | 19.6459 | 19.1941 | 18.8460 | (92)    |      |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |         |      |
| adjusted MIT                                                                | 18.8595 | 18.9990 | 19.2620 | 19.6316 | 19.9710 | 20.2089 | 20.2830 | 20.2714 | 20.0899                   | 19.6459 | 19.1941 | 18.8460 | (93)    |      |

#### 8. Space heating requirement

|                      |           |           |           |           |           |          |          |          |          |           |           |           |       |  |
|----------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|-----------|-------|--|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec       |       |  |
| Useful gains         | 531.6950  | 621.6051  | 725.3189  | 828.8816  | 855.7075  | 724.5119 | 528.9971 | 540.3177 | 644.5075 | 587.2350  | 518.0719  | 501.0375  | (94)  |  |
| 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     | 2251.7045 | 2174.9416 | 1963.7652 | 1631.8806 | 1254.9060 | 842.1365 | 552.9806 | 580.1287 | 902.9883 | 1372.4740 | 1843.2625 | 2242.7026 | (97)  |  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | 1.0000    | 1.0000    | (97a) |  |
| Space heating kWh    | 1279.6870 | 1043.8421 | 921.4040  | 578.1593  | 297.0036  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 584.2178  | 954.1372  | 1295.7988 | (98)  |  |
| Space heating        |           |           |           |           |           |          |          |          |          |           |           | 6954.2499 | (98)  |  |
| Space heating per m2 |           |           |           |           |           |          |          |          |          |           |           | 55.1706   | (99)  |  |

#### 8c. Space cooling requirement

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

|                   |        |        |        |        |         |           |           |           |         |         |        |          |        |  |
|-------------------|--------|--------|--------|--------|---------|-----------|-----------|-----------|---------|---------|--------|----------|--------|--|
| Ext. temp.        | Jan    | Feb    | Mar    | Apr    | May     | Jun       | Jul       | Aug       | Sep     | Oct     | Nov    | Dec      |        |  |
| 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   |        |  |
| Utilisation       | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1411.3516 | 1111.0640 | 1138.8700 | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (100)  |  |
| Useful loss       | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.7488    | 0.8365    | 0.7936    | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (101)  |  |
| Total gains       | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1056.8279 | 929.4458  | 903.8321  | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (102)  |  |
| Month fracti      | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1181.0575 | 1128.5382 | 1046.9807 | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (103)  |  |
| Space cooling kWh | 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     | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 89.4453   | 148.1247  | 106.5026  | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (104)  |  |
| Space cooling     |        |        |        |        |         |           |           |           |         |         |        | 344.0726 | (104)  |  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

|                                        |        |        |        |        |        |         |         |         |        |        |                          |               |
|----------------------------------------|--------|--------|--------|--------|--------|---------|---------|---------|--------|--------|--------------------------|---------------|
| 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 | 22.3613 | 37.0312 | 26.6256 | 0.0000 | 0.0000 | 0.0000                   | 0.0000 (107)  |
| Space cooling                          |        |        |        |        |        |         |         |         |        |        |                          | 86.0181 (107) |
| Space cooling per m2                   |        |        |        |        |        |         |         |         |        |        |                          | 0.6824 (108)  |
| Energy for space heating               |        |        |        |        |        |         |         |         |        |        |                          | 55.1706 (99)  |
| Energy for space cooling               |        |        |        |        |        |         |         |         |        |        |                          | 0.6824 (108)  |
| Total                                  |        |        |        |        |        |         |         |         |        |        |                          | 55.8530 (109) |
| Target Fabric Energy Efficiency (TFEE) |        |        |        |        |        |         |         |         |        |        |                          | 64.2 (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                                           | 11.8300 (1b)              | x 2.4000 (2b)                   | = 28.3920 (1b) - (3b)       |
| First floor                                            | 114.2200 (1c)             | x 2.4000 (2c)                   | = 274.1280 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 126.0500                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 302.5200 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m3 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                                               |                 |                      |       |                             | 3 * 10 = 30.0000 (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) = |                 |                      |       |                             | 30.0000 / (5) = 0.0992 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.1800                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3582 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 1 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3313 (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 | 0.3644 | 0.3396 | 0.3396 | 0.3230 | 0.3230 | 0.3065 | 0.3065 | 0.2899 | 0.2899 | 0.3147 | 0.3065 | 0.3230 (22b) |
| Effective ac    | 0.5664 | 0.5577 | 0.5577 | 0.5522 | 0.5522 | 0.5470 | 0.5470 | 0.5420 | 0.5420 | 0.5495 | 0.5470 | 0.5522 (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                                       |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------------------------------------------|
| Solid Doors                                                    |                         |                            | 2.1600                    | 1.4000                        | 3.0240       |                                | (26)                                                |
| Windows (Uw = 1.40)                                            |                         |                            | 16.0800                   | 1.3258                        | 21.3182      |                                | (27)                                                |
| Ground Floor                                                   |                         |                            | 11.8300                   | 0.1800                        | 2.1294       | 75.0000                        | 887.2500 (28a)                                      |
| Suspended Floor                                                |                         |                            | 102.3900                  | 0.1600                        | 16.3824      | 20.0000                        | 2047.8000 (28b)                                     |
| External Wall                                                  | 141.6000                | 18.2400                    | 123.3600                  | 0.2000                        | 24.6720      | 9.0000                         | 1110.2400 (29a)                                     |
| External Roof                                                  | 114.2200                |                            | 114.2200                  | 0.1000                        | 11.4220      | 9.0000                         | 1027.9800 (30)                                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 370.0400                  |                               |              |                                | (31)                                                |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 78.9480      |                                | (33)                                                |
| Party Wall                                                     |                         |                            | 16.3200                   | 0.0000                        | 0.0000       | 20.0000                        | 326.4000 (32)                                       |
| Internal Wall - FF                                             |                         |                            | 152.2800                  |                               |              | 9.0000                         | 1370.5200 (32c)                                     |
| Internal Ceiling                                               |                         |                            | 11.8300                   |                               |              | 18.0000                        | 212.9400 (32e)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 6983.1300 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 55.3997 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 18.4461 (36)                                        |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 97.3941 (37)                          |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| (38)m                     | 56.5453  | 55.6721  | 55.6721  | 55.1242  | 55.1242  | 54.6037  | 54.6037  | 54.1106  | 54.1106  | 54.8605  | 54.6037  | 55.1242 (38)  |
| Heat transfer coeff       | 153.9393 | 153.0661 | 153.0661 | 152.5182 | 152.5182 | 151.9977 | 151.9977 | 151.5046 | 151.5046 | 152.2546 | 151.9977 | 152.5182 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 152.4069 (39) |
| HLP                       | 1.2213   | 1.2143   | 1.2143   | 1.2100   | 1.2100   | 1.2059   | 1.2059   | 1.2019   | 1.2019   | 1.2079   | 1.2059   | 1.2100 (40)   |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.2091 (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                        |          |          |          |          |          |          |          |          |          |                    |          | 2.8840 (42)    |
| Average daily hot water use (litres/day) |          |          |          |          |          |          |          |          |          |                    |          | 102.6941 (43)  |
| Daily hot water use                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct                | Nov      | Dec            |
|                                          | 112.9635 | 108.8557 | 104.7479 | 100.6402 | 96.5324  | 92.4247  | 92.4247  | 96.5324  | 100.6402 | 104.7479           | 108.8557 | 112.9635 (44)  |
| Energy conte                             | 167.5216 | 146.5154 | 151.1908 | 131.8118 | 126.4766 | 109.1397 | 101.1339 | 116.0527 | 117.4387 | 136.8635           | 149.3972 | 162.2357 (45)  |
| Energy content (annual)                  |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = |          | 1615.7776 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |          |          |          |          |          |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF HEAT DEMAND 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| 25.1282                                                         | 21.9773  | 22.6786  | 19.7718  | 18.9715  | 16.3709  | 15.1701  | 17.4079  | 17.6158  | 20.5295  | 22.4096  | 24.3354 (46)  |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          | 205.0000 (47) |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          | 1.4000 (48)   |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          | 0.5400 (49)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          | 0.7560 (55)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |               |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |               |
| 23.4360                                                         | 21.1680  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360 (56)  |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |               |
| 23.4360                                                         | 21.1680  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |               |
| 214.2200                                                        | 188.6946 | 197.8892 | 177.0038 | 173.1750 | 154.3317 | 147.8323 | 162.7511 | 162.6307 | 183.5619 | 194.5892 | 208.9341 (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 (63)   |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |               |
| 214.2200                                                        | 188.6946 | 197.8892 | 177.0038 | 173.1750 | 154.3317 | 147.8323 | 162.7511 | 162.6307 | 183.5619 | 194.5892 | 208.9341 (64) |
| RHI water heating demand                                        |          |          |          |          |          |          |          |          |          |          |               |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |               |
| 93.0596                                                         | 82.4597  | 87.6297  | 79.9810  | 79.4122  | 72.4425  | 70.9858  | 75.9462  | 75.2020  | 82.8658  | 85.8282  | 91.3021 (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                                                                               | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 71.4815   | 63.4893   | 51.6329   | 39.0895   | 29.2198   | 24.6686   | 26.6553   | 34.6476   | 46.5039   | 59.0474   | 68.9170   | 73.4682 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 437.1551  | 441.6914  | 430.2601  | 405.9241  | 375.2043  | 346.3321  | 327.0436  | 322.5073  | 333.9387  | 358.2746  | 388.9944  | 417.8667 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877 (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)                                 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 (71) |
| Water heating gains (Table 5)                                                       | 125.0802  | 122.7079  | 117.7818  | 111.0848  | 106.7368  | 100.6146  | 95.4110   | 102.0783  | 104.4472  | 111.3788  | 119.2058  | 122.7179 (72)  |
| Total internal gains                                                                | 749.5837  | 743.7556  | 715.5417  | 671.9653  | 627.0279  | 587.4823  | 564.9768  | 575.1001  | 600.7567  | 644.5677  | 692.9841  | 729.9197 (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    |
|-------------|----------|----------|-----------|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|-----------|----------|------------------------------|---------------|
| East        |          |          |           |           | 7.5500     | 25.1925                        | 0.6300                            | 0.7000                             |           |          | 0.7700                       | 58.1287 (76)  |
| West        |          |          |           |           | 8.5300     | 25.1925                        | 0.6300                            | 0.7000                             |           |          | 0.7700                       | 65.6739 (80)  |
|             |          |          |           |           |            |                                |                                   |                                    |           |          |                              |               |
| Solar gains | 123.8026 | 206.0070 | 341.0763  | 498.3604  | 575.7994   | 645.5205                       | 593.1897                          | 532.9681                           | 415.1788  | 260.1927 | 153.8601                     | 96.3674 (83)  |
| Total gains | 873.3864 | 949.7625 | 1056.6180 | 1170.3257 | 1202.8273  | 1233.0027                      | 1158.1665                         | 1108.0682                          | 1015.9355 | 904.7604 | 846.8443                     | 826.2871 (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                                                                         | 12.6008 | 12.6727 | 12.6727 | 12.7182 | 12.7182 | 12.7618 | 12.7618 | 12.8033 | 12.8033 | 12.7402 | 12.7618 | 12.7182      |
| alpha                                                                       | 1.8401  | 1.8448  | 1.8448  | 1.8479  | 1.8479  | 1.8508  | 1.8508  | 1.8536  | 1.8536  | 1.8493  | 1.8508  | 1.8479       |
| util living area                                                            |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.8951  | 0.8759  | 0.8319  | 0.7577  | 0.6494  | 0.4939  | 0.3756  | 0.3880  | 0.5958  | 0.7727  | 0.8635  | 0.9018 (86)  |
| MIT                                                                         |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 17.9872 | 18.2385 | 18.8122 | 19.5202 | 20.2073 | 20.6885 | 20.8752 | 20.8685 | 20.5148 | 19.7430 | 18.7805 | 17.9715 (87) |
| Th 2                                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 19.9030 | 19.9086 | 19.9086 | 19.9120 | 19.9120 | 19.9153 | 19.9153 | 19.9184 | 19.9184 | 19.9137 | 19.9153 | 19.9120 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.8836  | 0.8624  | 0.8128  | 0.7281  | 0.6005  | 0.4164  | 0.2691  | 0.2794  | 0.5248  | 0.7372  | 0.8459  | 0.8909 (89)  |
| MIT 2                                                                       |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 17.1857 | 17.4350 | 17.9948 | 18.6781 | 19.3197 | 19.7336 | 19.8684 | 19.8686 | 19.6055 | 18.9063 | 17.9770 | 17.1771 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 17.4671 | 17.7171 | 18.2817 | 18.9737 | 19.6313 | 20.0688 | 20.2219 | 20.2196 | 19.9247 | 19.2000 | 18.2591 | 17.4560 (92) |
| MIT                                                                         |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 17.4671 | 17.7171 | 18.2817 | 18.9737 | 19.6313 | 20.0688 | 20.2219 | 20.2196 | 19.9247 | 19.2000 | 18.2591 | 17.4560 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 17.3171 | 17.5671 | 18.1317 | 18.8237 | 19.4813 | 19.9188 | 20.0719 | 20.0696 | 19.7747 | 19.0500 | 18.1091 | -0.1500      |
| adjusted MIT                                                                |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 17.3171 | 17.5671 | 18.1317 | 18.8237 | 19.4813 | 19.9188 | 20.0719 | 20.0696 | 19.7747 | 19.0500 | 18.1091 | 17.3060 (93) |

#### 8. Space heating requirement

|                          |           |           |           |           |          |          |          |          |          |           |           |                |
|--------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|-----------|-----------|----------------|
|                          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec            |
| Utilisation              | 0.8478    | 0.8249    | 0.7740    | 0.6932    | 0.5786   | 0.4166   | 0.2856   | 0.2957   | 0.5141   | 0.7029    | 0.8082    | 0.8561 (94)    |
| Useful gains             | 740.4462  | 783.4601  | 817.8215  | 811.2167  | 695.9430 | 513.7276 | 330.8166 | 327.7061 | 522.3084 | 635.9800  | 684.3879  | 707.3520 (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         |           |           |           |           |          |          |          |          |          |           |           |                |
|                          | 1834.5041 | 1785.8354 | 1612.0535 | 1345.7760 | 973.2608 | 610.8511 | 360.5188 | 359.0098 | 677.9438 | 1073.3973 | 1475.7609 | 1800.6335 (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        |           |           |           |           |          |          |          |          |          |           |           |                |
|                          | 813.9791  | 673.5962  | 590.9086  | 384.8827  | 206.3245 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 325.4385  | 569.7885  | 813.4015 (98)  |
| Space heating            |           |           |           |           |          |          |          |          |          |           |           |                |
|                          |           |           |           |           |          |          |          |          |          |           |           | 4378.3194 (98) |
| RHI space heating demand |           |           |           |           |          |          |          |          |          |           |           |                |
|                          |           |           |           |           |          |          |          |          |          |           |           | 4378 (98)      |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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# FULL SAP CALCULATION PRINTOUT

## 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                                           | 11.8300 (1b)              | x 2.4000 (2b)                   | = 28.3920 (1b) - (3b)       |
| First floor                                            | 114.2200 (1c)             | x 2.4000 (2c)                   | = 274.1280 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 126.0500                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 302.5200 (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                                               |                 |                      |       |                             | 3 * 10 = 30.0000 (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) = |                 |                      |       |                             | 30.0000 / (5) = 0.0992 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.1800                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3582 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 1 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3313 (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 | 0.4224 | 0.4141 | 0.4058 | 0.3644 | 0.3562 | 0.3147 | 0.3147 | 0.3065 | 0.3313 | 0.3562 | 0.3727 | 0.3893 (22b) |
| Effective ac    | 0.5892 | 0.5858 | 0.5824 | 0.5664 | 0.5634 | 0.5495 | 0.5495 | 0.5470 | 0.5549 | 0.5634 | 0.5695 | 0.5758 (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                                       |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------------------------------------------|
| Solid Doors                                                    |                         |                            | 2.1600                    | 1.4000                        | 3.0240       |                                | (26)                                                |
| Windows (Uw = 1.40)                                            |                         |                            | 16.0800                   | 1.3258                        | 21.3182      |                                | (27)                                                |
| Ground Floor                                                   |                         |                            | 11.8300                   | 0.1800                        | 2.1294       | 75.0000                        | 887.2500 (28a)                                      |
| Suspended Floor                                                |                         |                            | 102.3900                  | 0.1600                        | 16.3824      | 20.0000                        | 2047.8000 (28b)                                     |
| External Wall                                                  | 141.6000                | 18.2400                    | 123.3600                  | 0.2000                        | 24.6720      | 9.0000                         | 1110.2400 (29a)                                     |
| External Roof                                                  | 114.2200                |                            | 114.2200                  | 0.1000                        | 11.4220      | 9.0000                         | 1027.9800 (30)                                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 370.0400                  |                               |              |                                | (31)                                                |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 78.9480      |                                | (33)                                                |
| Party Wall                                                     |                         |                            | 16.3200                   | 0.0000                        | 0.0000       | 20.0000                        | 326.4000 (32)                                       |
| Internal Wall - FF                                             |                         |                            | 152.2800                  |                               |              | 9.0000                         | 1370.5200 (32c)                                     |
| Internal Ceiling                                               |                         |                            | 11.8300                   |                               |              | 18.0000                        | 212.9400 (32e)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 6983.1300 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 55.3997 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 18.4461 (36)                                        |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 97.3941 (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                     | 58.8224  | 58.4766  | 58.1376  | 56.5453  | 56.2473  | 54.8605  | 54.8605  | 54.6037  | 55.3947  | 56.2473  | 56.8500  | 57.4801 (38)  |
| Heat transfer coeff       | 156.2165 | 155.8706 | 155.5316 | 153.9393 | 153.6414 | 152.2546 | 152.2546 | 151.9977 | 152.7888 | 153.6414 | 154.2441 | 154.8742 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 153.9379 (39) |
|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| HLP                       | 1.2393   | 1.2366   | 1.2339   | 1.2213   | 1.2189   | 1.2079   | 1.2079   | 1.2059   | 1.2121   | 1.2189   | 1.2237   | 1.2287 (40)   |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.2212 (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                        |          |          |          |          |          |          |          |          |          |                    |          | 2.8840 (42)    |
|------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------------|----------|----------------|
| Average daily hot water use (litres/day) |          |          |          |          |          |          |          |          |          |                    |          | 102.6941 (43)  |
|                                          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct                | Nov      | Dec            |
| Daily hot water use                      | 112.9635 | 108.8557 | 104.7479 | 100.6402 | 96.5324  | 92.4247  | 92.4247  | 96.5324  | 100.6402 | 104.7479           | 108.8557 | 112.9635 (44)  |
| Energy conte                             | 167.5216 | 146.5154 | 151.1908 | 131.8118 | 126.4766 | 109.1397 | 101.1339 | 116.0527 | 117.4387 | 136.8635           | 149.3972 | 162.2357 (45)  |
| Energy content (annual)                  |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = |          | 1615.7776 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |          |          |          |          |          |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| 25.1282                                                         | 21.9773  | 22.6786  | 19.7718  | 18.9715  | 16.3709  | 15.1701  | 17.4079  | 17.6158  | 20.5295  | 22.4096  | 24.3354 (46)  |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |               |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          | 205.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          | 1.4000 (48)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          | 0.5400 (49)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          | 0.7560 (55)   |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |               |
| 23.4360                                                         | 21.1680  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360 (56)  |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |               |
| 23.4360                                                         | 21.1680  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |               |
| 214.2200                                                        | 188.6946 | 197.8892 | 177.0038 | 173.1750 | 154.3317 | 147.8323 | 162.7511 | 162.6307 | 183.5619 | 194.5892 | 208.9341 (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 (63)   |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)   |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |               |
| 214.2200                                                        | 188.6946 | 197.8892 | 177.0038 | 173.1750 | 154.3317 | 147.8323 | 162.7511 | 162.6307 | 183.5619 | 194.5892 | 208.9341 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |               |
| 93.0596                                                         | 82.4597  | 87.6297  | 79.9810  | 79.4122  | 72.4425  | 70.9858  | 75.9462  | 75.2020  | 82.8658  | 85.8282  | 91.3021 (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                                                                               | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 71.4815   | 63.4893   | 51.6329   | 39.0895   | 29.2198   | 24.6686   | 26.6553   | 34.6476   | 46.5039   | 59.0474   | 68.9170   | 73.4682 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 437.1551  | 441.6914  | 430.2601  | 405.9241  | 375.2043  | 346.3321  | 327.0436  | 322.5073  | 333.9387  | 358.2746  | 388.9944  | 417.8667 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877 (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)                                 |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 (71) |
| Water heating gains (Table 5)                                                       |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 125.0802  | 122.7079  | 117.7818  | 111.0848  | 106.7368  | 100.6146  | 95.4110   | 102.0783  | 104.4472  | 111.3788  | 119.2058  | 122.7179 (72)  |
| Total internal gains                                                                |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 749.5837  | 743.7556  | 715.5417  | 671.9653  | 627.0279  | 587.4823  | 564.9768  | 575.1001  | 600.7567  | 644.5677  | 692.9841  | 729.9197 (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    |
|-------------|----------|----------|-----------|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|----------|---------------|
| East        |          |          |           |           | 7.5500     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       |          |          | 45.3175 (76)  |
| West        |          |          |           |           | 8.5300     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       |          |          | 51.1998 (80)  |
| -----       |          |          |           |           |            |                                |                                   |                                    |                              |          |          |               |
| Solar gains | 96.5173  | 188.8083 | 310.9404  | 453.4881  | 555.7666   | 568.9260                       | 541.6408                          | 465.2614                           | 361.6366                     | 224.0370 | 120.3457 | 79.3711 (83)  |
| Total gains | 846.1010 | 932.5639 | 1026.4822 | 1125.4533 | 1182.7945  | 1156.4083                      | 1106.6176                         | 1040.3615                          | 962.3932                     | 868.6047 | 813.3299 | 809.2908 (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                                                                         | 12.4171 | 12.4447 | 12.4718 | 12.6008 | 12.6252 | 12.7402 | 12.7402 | 12.7618 | 12.6957 | 12.6252             | 12.5759 | 12.5247      |
| alpha                                                                       | 1.8278  | 1.8296  | 1.8315  | 1.8401  | 1.8417  | 1.8493  | 1.8493  | 1.8508  | 1.8464  | 1.8417              | 1.8384  | 1.8350       |
| util living area                                                            |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 0.9100  | 0.8906  | 0.8556  | 0.7942  | 0.7074  | 0.5924  | 0.4812  | 0.5163  | 0.6778  | 0.8195              | 0.8884  | 0.9161 (86)  |
| MIT                                                                         |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 17.6103 | 17.9008 | 18.4548 | 19.1978 | 19.8972 | 20.4581 | 20.7428 | 20.6961 | 20.2489 | 19.3499             | 18.3592 | 17.5521 (87) |
| Th 2                                                                        |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 19.8887 | 19.8908 | 19.8930 | 19.9030 | 19.9049 | 19.9137 | 19.9137 | 19.9153 | 19.9103 | 19.9049             | 19.9011 | 19.8971 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 0.9005  | 0.8791  | 0.8396  | 0.7697  | 0.6685  | 0.5296  | 0.3909  | 0.4280  | 0.6222  | 0.7930              | 0.8747  | 0.9073 (89)  |
| MIT 2                                                                       |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 16.8042 | 17.0909 | 17.6357 | 18.3638 | 19.0299 | 19.5456 | 19.7791 | 19.7484 | 19.3704 | 18.5253             | 17.5545 | 16.7525 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             |         |         |         |         |         |         |         |         | fLA =   | Living area / (4) = |         | 0.3511 (91)  |
| MIT                                                                         |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 17.0871 | 17.3752 | 17.9233 | 18.6565 | 19.3343 | 19.8659 | 20.1174 | 20.0811 | 19.6788 | 18.8148             | 17.8370 | 17.0332 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             |         |         |         |         |         |         |         |         |         |                     |         | -0.1500      |
| adjusted MIT                                                                |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 16.9371 | 17.2252 | 17.7733 | 18.5065 | 19.1843 | 19.7159 | 19.9674 | 19.9311 | 19.5288 | 18.6648             | 17.6870 | 16.8832 (93) |

#### 8. Space heating requirement

|                      |           |           |           |           |           |          |          |          |          |           |           |                           |
|----------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|---------------------------|
|                      | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec                       |
| Utilisation          | 0.8664    | 0.8425    | 0.8007    | 0.7320    | 0.6389    | 0.5169   | 0.3958   | 0.4294   | 0.5996   | 0.7555    | 0.8383    | 0.8743 (94)               |
| Useful gains         | 733.0433  | 785.6697  | 821.9419  | 823.8644  | 755.7138  | 597.7148 | 438.0380 | 446.7524 | 577.0718 | 656.1940  | 681.7942  | 707.5518 (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     |           |           |           |           |           |          |          |          |          |           |           |                           |
|                      | 1974.1303 | 1921.1441 | 1753.3486 | 1478.8241 | 1149.9046 | 778.9230 | 512.6965 | 536.7180 | 829.4604 | 1239.0824 | 1632.9796 | 1964.2988 (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    |           |           |           |           |           |          |          |          |          |           |           |                           |
|                      | 923.3687  | 763.0388  | 692.9666  | 471.5710  | 293.2780  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 433.6689  | 684.8535  | 935.0198 (98)             |
| Space heating        |           |           |           |           |           |          |          |          |          |           |           |                           |
|                      |           |           |           |           |           |          |          |          |          |           |           | 5197.7653 (98)            |
| Space heating per m2 |           |           |           |           |           |          |          |          |          |           |           |                           |
|                      |           |           |           |           |           |          |          |          |          |           |           | (98) / (4) = 41.2357 (99) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 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 %)                      |           |          |          |          |          |          |          |          |          |           |          |           | 90.4000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |           |          |          |          |          |          |          |          |          |           |          |           | 0.0000 (208)    |
| Space heating requirement                                             |           |          |          |          |          |          |          |          |          |           |          |           | 5749.7404 (211) |
|                                                                       | Jan       | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct       | Nov      | Dec       |                 |
| Space heating requirement                                             | 923.3687  | 763.0388 | 692.9666 | 471.5710 | 293.2780 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 433.6689  | 684.8535 | 935.0198  | (98)            |
| Space heating efficiency (main heating system 1)                      | 90.4000   | 90.4000  | 90.4000  | 90.4000  | 90.4000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 90.4000   | 90.4000  | 90.4000   | (210)           |
| Space heating fuel (main heating system)                              | 1021.4256 | 844.0695 | 766.5559 | 521.6494 | 324.4225 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 479.7223  | 757.5813 | 1034.3140 | (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                                             | 214.2200  | 188.6946 | 197.8892 | 177.0038 | 173.1750 | 154.3317 | 147.8323 | 162.7511 | 162.6307 | 183.5619  | 194.5892 | 208.9341  | (64)            |
| Efficiency of water heater (217)m                                     | 88.1709   | 88.0562  | 87.7821  | 87.2049  | 86.1081  | 79.7000  | 79.7000  | 79.7000  | 79.7000  | 86.9292   | 87.7921  | 79.7000   | (216)           |
| Fuel for water heating, kWh/month                                     | 242.9599  | 214.2890 | 225.4322 | 202.9747 | 201.1134 | 193.6407 | 185.4860 | 204.2046 | 204.0536 | 211.1625  | 221.6478 | 236.7890  | (219)           |
| Water heating fuel used                                               |           |          |          |          |          |          |          |          |          |           |          | 2543.7533 | (219)           |
| Annual totals kWh/year                                                |           |          |          |          |          |          |          |          |          |           |          |           |                 |
| Space heating fuel - main system                                      |           |          |          |          |          |          |          |          |          |           |          | 5749.7404 | (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)                   |           |          |          |          |          |          |          |          |          |           |          | 504.9545  | (232)           |
| Energy saving/generation technologies (Appendices M ,N and Q)         |           |          |          |          |          |          |          |          |          |           |          |           |                 |
| PV Unit 0 (0.80 * 0.96 * 853 * 1.00) =                                |           |          |          |          |          |          |          |          |          | -655.1270 |          | -655.1270 | (233)           |
| Total delivered energy for all uses                                   |           |          |          |          |          |          |          |          |          |           |          | 8218.3212 | (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         | 5749.7404        | 3.4800              | 200.0910 (240)      |
| Space heating - secondary             | 0.0000           | 0.0000              | 0.0000 (242)        |
| Water heating (other fuel)            | 2543.7533        | 3.4800              | 88.5226 (247)       |
| Pumps and fans for heating            | 75.0000          | 13.1900             | 9.8925 (249)        |
| Energy for lighting                   | 504.9545         | 13.1900             | 66.6035 (250)       |
| Additional standing charges           |                  |                     | 120.0000 (251)      |
| Energy saving/generation technologies |                  |                     |                     |
| PV Unit                               | -655.1270        | 13.1900             | -86.4112 (252)      |
| Total energy cost                     |                  |                     | 398.6983 (255)      |

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

|                                  |                                  |              |
|----------------------------------|----------------------------------|--------------|
| Energy cost deflator (Table 12): |                                  | 0.4200 (256) |
| Energy cost factor (ECF)         | [(255) x (256)] / [(4) + 45.0] = | 0.9790 (257) |
| SAP value                        |                                  | 86.3433      |
| SAP rating (Section 12)          |                                  | 86 (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         | 5749.7404          | 0.2160                        | 1241.9439 (261)          |
| Space heating - secondary             | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)            | 2543.7533          | 0.2160                        | 549.4507 (264)           |
| Space and water heating               |                    |                               | 1791.3946 (265)          |
| Pumps and fans                        | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                   | 504.9545           | 0.5190                        | 262.0714 (268)           |
| Energy saving/generation technologies |                    |                               |                          |
| PV Unit                               | -655.1270          | 0.5190                        | -340.0109 (269)          |
| Total kg/year                         |                    |                               | 1752.3801 (272)          |
| CO2 emissions per m2                  |                    |                               | 13.9000 (273)            |
| EI value                              |                    |                               | 86.2719                  |
| EI rating                             |                    |                               | 86 (274)                 |
| EI band                               |                    |                               | B                        |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

|                                    |                                                                     |
|------------------------------------|---------------------------------------------------------------------|
| Main heating energy efficiency     | $3.48 \times (1 + 0.29 \times 0.00) / 0.9040 = 3.850$ , stars = 4   |
| Main heating environmental impact  | $0.216 \times (1 + 0.29 \times 0.00) / 0.9040 = 0.2389$ , stars = 4 |
| Water heating energy efficiency    | $3.48 / 0.8492 = 4.098$ , stars = 4                                 |
| Water heating environmental impact | $0.216 / 0.8492 = 0.2543$ , stars = 4                               |

# 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                                           | 11.8300 (1b)              | x 2.4000 (2b)                   | = 28.3920 (1b) - (3b)       |
| First floor                                            | 114.2200 (1c)             | x 2.4000 (2c)                   | = 274.1280 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 126.0500                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 302.5200 (5)              |

#### 2. Ventilation rate

|                                                      | main heating                 |        | secondary 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                          |                              |        |                   |        |        |        |        | 3 * 10 =                    | 30.0000 (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) = |        |                   |        |        |        |        | 30.0000 / (5) =             | 0.0992 (8)   |        |        |              |
| Pressure test                                        |                              |        |                   |        |        |        |        | Yes                         |              |        |        |              |
| Measured/design AP50                                 |                              |        |                   |        |        |        |        | 5.1800                      |              |        |        |              |
| Infiltration rate                                    |                              |        |                   |        |        |        |        | 0.3582 (18)                 |              |        |        |              |
| Number of sides sheltered                            |                              |        |                   |        |        |        |        | 1 (19)                      |              |        |        |              |
| Shelter factor                                       |                              |        |                   |        |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)  |        |        |              |
| Infiltration rate adjusted to include shelter factor |                              |        |                   |        |        |        |        | (21) = (18) x (20) =        | 0.3313 (21)  |        |        |              |
| Wind speed                                           | Jan                          | Feb    | Mar               | Apr    | May    | Jun    | Jul    | Aug                         | Sep          | Oct    | Nov    | Dec          |
| Wind factor                                          | 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)  |
| Adj infilt rate                                      | 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) |
| Effective ac                                         | 0.3644                       | 0.3396 | 0.3396            | 0.3230 | 0.3230 | 0.3065 | 0.3065 | 0.2899                      | 0.2899       | 0.3147 | 0.3065 | 0.3230 (22b) |
|                                                      | 0.5664                       | 0.5577 | 0.5577            | 0.5522 | 0.5522 | 0.5470 | 0.5470 | 0.5420                      | 0.5420       | 0.5495 | 0.5470 | 0.5522 (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                                       |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------------------------------------------|
| Solid Doors                                                    |                         |                            | 2.1600                    | 1.4000                        | 3.0240       |                                | (26)                                                |
| Windows (Uw = 1.40)                                            |                         |                            | 16.0800                   | 1.3258                        | 21.3182      |                                | (27)                                                |
| Ground Floor                                                   |                         |                            | 11.8300                   | 0.1800                        | 2.1294       | 75.0000                        | 887.2500 (28a)                                      |
| Suspended Floor                                                |                         |                            | 102.3900                  | 0.1600                        | 16.3824      | 20.0000                        | 2047.8000 (28b)                                     |
| External Wall                                                  | 141.6000                | 18.2400                    | 123.3600                  | 0.2000                        | 24.6720      | 9.0000                         | 1110.2400 (29a)                                     |
| External Roof                                                  | 114.2200                |                            | 114.2200                  | 0.1000                        | 11.4220      | 9.0000                         | 1027.9800 (30)                                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 370.0400                  |                               |              |                                | (31)                                                |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 78.9480      |                                | (33)                                                |
| Party Wall                                                     |                         |                            | 16.3200                   | 0.0000                        | 0.0000       | 20.0000                        | 326.4000 (32)                                       |
| Internal Wall - FF                                             |                         |                            | 152.2800                  |                               |              | 9.0000                         | 1370.5200 (32c)                                     |
| Internal Ceiling                                               |                         |                            | 11.8300                   |                               |              | 18.0000                        | 212.9400 (32e)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 6983.1300 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 55.3997 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 18.4461 (36)                                        |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 97.3941 (37)                          |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| (38)m                     | 56.5453  | 55.6721  | 55.6721  | 55.1242  | 55.1242  | 54.6037  | 54.6037  | 54.1106  | 54.1106  | 54.8605  | 54.6037  | 55.1242 (38)  |
| Heat transfer coeff       | 153.9393 | 153.0661 | 153.0661 | 152.5182 | 152.5182 | 151.9977 | 151.9977 | 151.5046 | 151.5046 | 152.2546 | 151.9977 | 152.5182 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 152.4069 (39) |
| HLP                       | 1.2213   | 1.2143   | 1.2143   | 1.2100   | 1.2100   | 1.2059   | 1.2059   | 1.2019   | 1.2019   | 1.2079   | 1.2059   | 1.2100 (40)   |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.2091 (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                        |              |              |              |              |             |             |             |             |              |              |              | 2.8840 (42)                       |
| Average daily hot water use (litres/day) |              |              |              |              |             |             |             |             |              |              |              | 102.6941 (43)                     |
| Daily hot water use                      | Jan 112.9635 | Feb 108.8557 | Mar 104.7479 | Apr 100.6402 | May 96.5324 | Jun 92.4247 | Jul 92.4247 | Aug 96.5324 | Sep 100.6402 | Oct 104.7479 | Nov 108.8557 | Dec 112.9635 (44)                 |
| Energy conte                             | 167.5216     | 146.5154     | 151.1908     | 131.8118     | 126.4766    | 109.1397    | 101.1339    | 116.0527    | 117.4387     | 136.8635     | 149.3972     | 162.2357 (45)                     |
| Energy content (annual)                  |              |              |              |              |             |             |             |             |              |              |              | Total = Sum(45)m = 1615.7776 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |              |              |              |              |             |             |             |             |              |              |              |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

|                                                                 |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| 25.1282                                                         | 21.9773  | 22.6786  | 19.7718  | 18.9715  | 16.3709  | 15.1701  | 17.4079  | 17.6158  | 20.5295  | 22.4096  | 24.3354 (46)  |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |               |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          | 205.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          | 1.4000 (48)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          | 0.5400 (49)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          | 0.7560 (55)   |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |               |
| 23.4360                                                         | 21.1680  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360 (56)  |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |               |
| 23.4360                                                         | 21.1680  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |               |
| 214.2200                                                        | 188.6946 | 197.8892 | 177.0038 | 173.1750 | 154.3317 | 147.8323 | 162.7511 | 162.6307 | 183.5619 | 194.5892 | 208.9341 (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 (63)   |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)   |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |               |
| 214.2200                                                        | 188.6946 | 197.8892 | 177.0038 | 173.1750 | 154.3317 | 147.8323 | 162.7511 | 162.6307 | 183.5619 | 194.5892 | 208.9341 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |               |
| 93.0596                                                         | 82.4597  | 87.6297  | 79.9810  | 79.4122  | 72.4425  | 70.9858  | 75.9462  | 75.2020  | 82.8658  | 85.8282  | 91.3021 (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                                                                               | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376  | 173.0376 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 71.4815   | 63.4893   | 51.6329   | 39.0895   | 29.2198   | 24.6686   | 26.6553   | 34.6476   | 46.5039   | 59.0474   | 68.9170   | 73.4682 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 437.1551  | 441.6914  | 430.2601  | 405.9241  | 375.2043  | 346.3321  | 327.0436  | 322.5073  | 333.9387  | 358.2746  | 388.9944  | 417.8667 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877   | 55.1877 (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)                                 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 | -115.3584 (71) |
| Water heating gains (Table 5)                                                       | 125.0802  | 122.7079  | 117.7818  | 111.0848  | 106.7368  | 100.6146  | 95.4110   | 102.0783  | 104.4472  | 111.3788  | 119.2058  | 122.7179 (72)  |
| Total internal gains                                                                | 749.5837  | 743.7556  | 715.5417  | 671.9653  | 627.0279  | 587.4823  | 564.9768  | 575.1001  | 600.7567  | 644.5677  | 692.9841  | 729.9197 (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   |
|-------------|----------|----------|-----------|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|-----------|----------|------------------------------|---------------|--|--------------|
| East        |          |          |           |           | 7.5500     | 25.1925                        | 0.6300                            | 0.7000                             |           |          | 0.7700                       |               |  | 58.1287 (76) |
| West        |          |          |           |           | 8.5300     | 25.1925                        | 0.6300                            | 0.7000                             |           |          | 0.7700                       |               |  | 65.6739 (80) |
|             |          |          |           |           |            |                                |                                   |                                    |           |          |                              |               |  |              |
| Solar gains | 123.8026 | 206.0070 | 341.0763  | 498.3604  | 575.7994   | 645.5205                       | 593.1897                          | 532.9681                           | 415.1788  | 260.1927 | 153.8601                     | 96.3674 (83)  |  |              |
| Total gains | 873.3864 | 949.7625 | 1056.6180 | 1170.3257 | 1202.8273  | 1233.0027                      | 1158.1665                         | 1108.0682                          | 1015.9355 | 904.7604 | 846.8443                     | 826.2871 (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                                                                         | 12.6008 | 12.6727 | 12.6727 | 12.7182 | 12.7182 | 12.7618 | 12.7618 | 12.8033 | 12.8033 | 12.7402             | 12.7618 | 12.7182      |
| alpha                                                                       | 1.8401  | 1.8448  | 1.8448  | 1.8479  | 1.8479  | 1.8508  | 1.8508  | 1.8536  | 1.8536  | 1.8493              | 1.8508  | 1.8479       |
| util living area                                                            |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 0.8951  | 0.8759  | 0.8319  | 0.7577  | 0.6494  | 0.4939  | 0.3756  | 0.3880  | 0.5958  | 0.7727              | 0.8635  | 0.9018 (86)  |
| MIT                                                                         |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 17.9872 | 18.2385 | 18.8122 | 19.5202 | 20.2073 | 20.6885 | 20.8752 | 20.8685 | 20.5148 | 19.7430             | 18.7805 | 17.9715 (87) |
| Th 2                                                                        |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 19.9030 | 19.9086 | 19.9086 | 19.9120 | 19.9120 | 19.9153 | 19.9153 | 19.9184 | 19.9184 | 19.9137             | 19.9153 | 19.9120 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 0.8836  | 0.8624  | 0.8128  | 0.7281  | 0.6005  | 0.4164  | 0.2691  | 0.2794  | 0.5248  | 0.7372              | 0.8459  | 0.8909 (89)  |
| MIT 2                                                                       |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 17.1857 | 17.4350 | 17.9948 | 18.6781 | 19.3197 | 19.7336 | 19.8684 | 19.8686 | 19.6055 | 18.9063             | 17.9770 | 17.1771 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             |         |         |         |         |         |         |         |         | fLA =   | Living area / (4) = |         | 0.3511 (91)  |
| MIT                                                                         |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 17.4671 | 17.7171 | 18.2817 | 18.9737 | 19.6313 | 20.0688 | 20.2219 | 20.2196 | 19.9247 | 19.2000             | 18.2591 | 17.4560 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             |         |         |         |         |         |         |         |         |         |                     |         | -0.1500      |
| adjusted MIT                                                                |         |         |         |         |         |         |         |         |         |                     |         |              |
|                                                                             | 17.3171 | 17.5671 | 18.1317 | 18.8237 | 19.4813 | 19.9188 | 20.0719 | 20.0696 | 19.7747 | 19.0500             | 18.1091 | 17.3060 (93) |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |              |           |                |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------------|-----------|----------------|
|                      | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec            |
| Utilisation          | 0.8478    | 0.8249    | 0.7740    | 0.6932    | 0.5786   | 0.4166   | 0.2856   | 0.2957   | 0.5141   | 0.7029       | 0.8082    | 0.8561 (94)    |
| Useful gains         |           |           |           |           |          |          |          |          |          |              |           |                |
|                      | 740.4462  | 783.4601  | 817.8215  | 811.2167  | 695.9430 | 513.7276 | 330.8166 | 327.7061 | 522.3084 | 635.9800     | 684.3879  | 707.3520 (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     |           |           |           |           |          |          |          |          |          |              |           |                |
|                      | 1834.5041 | 1785.8354 | 1612.0535 | 1345.7760 | 973.2608 | 610.8511 | 360.5188 | 359.0098 | 677.9438 | 1073.3973    | 1475.7609 | 1800.6335 (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    |           |           |           |           |          |          |          |          |          |              |           |                |
|                      | 813.9791  | 673.5962  | 590.9086  | 384.8827  | 206.3245 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 325.4385     | 569.7885  | 813.4015 (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |              |           |                |
|                      |           |           |           |           |          |          |          |          |          |              |           | 4378.3194 (98) |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |              |           |                |
|                      |           |           |           |           |          |          |          |          |          | (98) / (4) = |           | 34.7348 (99)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

8c. Space cooling requirement

Not applicable

#### 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 %)                      |          |          |          |          |          |          |          |          |          |           |          |           | 90.4000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |           |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |           |          |           | 4843.2737 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct       | Nov      | Dec       |                 |
| Space heating requirement                                             | 813.9791 | 673.5962 | 590.9086 | 384.8827 | 206.3245 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 325.4385  | 569.7885 | 813.4015  | (98)            |
| Space heating efficiency (main heating system 1)                      | 90.4000  | 90.4000  | 90.4000  | 90.4000  | 90.4000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 90.4000   | 90.4000  | 90.4000   | (210)           |
| Space heating fuel (main heating system)                              | 900.4193 | 745.1285 | 653.6600 | 425.7552 | 228.2350 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 359.9983  | 630.2970 | 899.7804  | (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                                             | 214.2200 | 188.6946 | 197.8892 | 177.0038 | 173.1750 | 154.3317 | 147.8323 | 162.7511 | 162.6307 | 183.5619  | 194.5892 | 208.9341  | (64)            |
| Efficiency of water heater (217)m                                     | 87.9402  | 87.8200  | 87.4545  | 86.7319  | 85.1815  | 79.7000  | 79.7000  | 79.7000  | 79.7000  | 86.2253   | 87.4125  | 79.7000   | (216)           |
| Fuel for water heating, kWh/month                                     | 243.5973 | 214.8653 | 226.2768 | 204.0815 | 203.3011 | 193.6407 | 185.4860 | 204.2046 | 204.0536 | 212.8863  | 222.6103 | 237.4631  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |           |          | 2552.4667 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |           |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |           |          | 4843.2737 | (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)                   |          |          |          |          |          |          |          |          |          |           |          | 504.9545  | (232)           |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |          |          |          |          |          |           |          |           |                 |
| PV Unit 0 (0.80 * 0.96 * 961 * 1.00) =                                |          |          |          |          |          |          |          |          |          | -737.8880 |          | -737.8880 | (233)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |           |          | 7237.8069 | (238)           |

#### 10a. Fuel costs - using BEDF prices (513)

|                                       | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |       |
|---------------------------------------|------------------|---------------------|---------------------|-------|
| Space heating - main system 1         | 4843.2737        | 9.7400              | 471.7349            | (240) |
| Space heating - secondary             | 0.0000           | 0.0000              | 0.0000              | (242) |
| Water heating (other fuel)            | 2552.4667        | 9.7400              | 248.6103            | (247) |
| Pumps and fans for heating            | 75.0000          | 36.8500             | 27.6375             | (249) |
| Energy for lighting                   | 504.9545         | 36.8500             | 186.0757            | (250) |
| Additional standing charges           |                  |                     | 104.0000            | (251) |
| Energy saving/generation technologies |                  |                     |                     |       |
| PV Unit                               | -737.8880        | 36.8500             | -271.9117           | (252) |
| Total energy cost                     |                  |                     | 766.1466            | (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         | 4843.2737          | 0.2160                        | 1046.1471                | (261) |
| Space heating - secondary             | 0.0000             | 0.0000                        | 0.0000                   | (263) |
| Water heating (other fuel)            | 2552.4667          | 0.2160                        | 551.3328                 | (264) |
| Space and water heating               |                    |                               | 1597.4799                | (265) |
| Pumps and fans                        | 75.0000            | 0.5190                        | 38.9250                  | (267) |
| Energy for lighting                   | 504.9545           | 0.5190                        | 262.0714                 | (268) |
| Energy saving/generation technologies |                    |                               |                          |       |
| PV Unit                               | -737.8880          | 0.5190                        | -382.9639                | (269) |
| Total kg/year                         |                    |                               | 1515.5124                | (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         | 4843.2737          | 1.2200                              | 5908.7939                  | (261) |
| Space heating - secondary             | 0.0000             | 0.0000                              | 0.0000                     | (263) |
| Water heating (other fuel)            | 2552.4667          | 1.2200                              | 3114.0094                  | (264) |
| Space and water heating               |                    |                                     | 9022.8033                  | (265) |
| Pumps and fans                        | 75.0000            | 3.0700                              | 230.2500                   | (267) |
| Energy for lighting                   | 504.9545           | 3.0700                              | 1550.2102                  | (268) |
| Energy saving/generation technologies |                    |                                     |                            |       |
| PV Unit                               | -737.8880          | 3.0700                              | -2265.3162                 | (269) |
| Primary energy kWh/year               |                    |                                     | 8537.9473                  | (272) |
| Primary energy kWh/m2/year            |                    |                                     | 67.7346                    | (273) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

#### SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 86  
Current environmental impact rating: B 86

(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: (none)      SAP change      Cost change      CO2 change

Recommended measures (none)      Typical annual savings      Energy efficiency      Environmental impact

Total Savings £0      0.00 kg/m²

Potential energy efficiency rating: B 86  
Potential environmental impact rating: B 86

Fuel prices for cost data on this page from database revision number 513 TEST (28 Feb 2023)  
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              | £214       | £214       | £0         |
| Mains gas                | £824       | £824       | £0         |
| Space heating            | £603       | £603       | £0         |
| Water heating            | £249       | £249       | £0         |
| Lighting                 | £186       | £186       | £0         |
| Generated (PV)           | -£272      | -£272      | £0         |
| Total cost of fuels      | £766       | £766       | £0         |
| Total cost of uses       | £766       | £766       | £0         |
| Delivered energy         | 57 kWh/m²  | 57 kWh/m²  | 0 kWh/m²   |
| Carbon dioxide emissions | 1.5 tonnes | 1.5 tonnes | 0.0 tonnes |
| CO2 emissions per m²     | 12 kg/m²   | 12 kg/m²   | 0 kg/m²    |
| Primary energy           | 68 kWh/m²  | 68 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                             | EndTerrace Maisonette                        |
| Number of storeys                         | 2                                            |
| Cross ventilation possible                | Yes                                          |
| SAP Region                                | Southern England                             |
| Front of dwelling faces                   | West                                         |
| Overshading                               | Average or unknown                           |
| Thermal mass parameter                    | 55.4 (calculated from construction elements) |
| Night ventilation                         | Yes                                          |
| Ventilation rate during hot weather (ach) | 8.00 (Windows fully open)                    |

#### Overheating Calculation

|                                          |             |
|------------------------------------------|-------------|
| Summer ventilation heat loss coefficient | 798.65 (P1) |
| Transmission heat loss coefficient       | 97.39 (37)  |
| Summer heat loss coefficient             | 896.05 (P2) |

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

  

| Solar shading | Z blinds | Solar access | Z overhangs | Z summer   |
|---------------|----------|--------------|-------------|------------|
| Orientation   |          |              |             |            |
| East          | 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 |
|--------|------------|--------------------------------|-----------------------------------|------------------------------------|---------|------------|
| East   | 7.5500     | 125.2818                       | 0.6300                            | 0.7000                             | 0.9000  | 337.8769   |
| West   | 8.5300     | 125.2818                       | 0.6300                            | 0.7000                             | 0.9000  | 381.7338   |
| total: |            |                                |                                   |                                    |         | 719.6107   |

|                                                        |                 |                 |                 |      |
|--------------------------------------------------------|-----------------|-----------------|-----------------|------|
| Solar gains                                            | Jun             | Jul             | Aug             | (P3) |
|                                                        | 774             | 720             | 633             |      |
| Internal gains                                         | 584             | 562             | 572             |      |
| Total summer gains                                     | 1358            | 1282            | 1205            | (P5) |
| Summer gain/loss ratio                                 | 1.52            | 1.43            | 1.34            | (P6) |
| Summer external temperature                            | 15.40           | 17.30           | 17.30           |      |
| Thermal mass temperature increment (TMP = 55.4)        | 1.61            | 1.61            | 1.61            |      |
| Threshold temperature                                  | 18.53           | 20.34           | 20.26           | (P7) |
| Likelihood of high internal temperature                | Not significant | Not significant | Not significant |      |
| Assessment of likelihood of high internal temperature: | Not significant |                 |                 |      |