# Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.5
*Printed on Tuesday, January 10, 2017 at 11:53:48 AM*

## Project Information:

**Assessed By:** Chloe Hewitt (STRO029693) **Building Type:** Semi-detached House

## Dwelling Details:

**NEW DWELLING DESIGN STAGE** Total Floor Area: 85.66m²
**Site Reference :** Wardentree Lane **Plot Reference:** Plot 156
**Address :** Plot 156, Land off Wardentree Lane, Spalding

## Client Details:

**Name:** Allison Homes
**Address :**

**This report covers items included within the SAP calculations.**
**It is not a complete report of regulations compliance.**

## 1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

| | | |
|---|---|---|
| Target Carbon Dioxide Emission Rate (TER) | 18.32 kg/m² | |
| Dwelling Carbon Dioxide Emission Rate (DER) | 14.28 kg/m² | **OK** |

## 1b TFEE and DFEE

| | | |
|---|---|---|
| Target Fabric Energy Efficiency (TFEE) | 54.2 kWh/m² | |
| Dwelling Fabric Energy Efficiency (DFEE) | 52.0 kWh/m² | |
| | | **OK** |

## 2 Fabric U-values

| Element | Average | Highest | |
|---|---|---|---|
| External wall | 0.22 (max. 0.30) | 0.22 (max. 0.70) | **OK** |
| Party wall | 0.00 (max. 0.20) | - | **OK** |
| Floor | 0.12 (max. 0.25) | 0.12 (max. 0.70) | **OK** |
| Roof | 0.09 (max. 0.20) | 0.09 (max. 0.35) | **OK** |
| Openings | 1.38 (max. 2.00) | 1.43 (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 | 5.00 (design value) | |
| Maximum | 10.0 | **OK** |

## 4 Heating efficiency

Main Heating system: Database: (rev 404, product index 017688):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Vaillant
Model: ecoTEC pro 30 H combi A
Model qualifier: VUW GB 306/5-3 (Combi)
Efficiency 89.3 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: None

# Regulations Compliance Report

## 5 Cylinder insulation

| | | |
|---|---|---|
| Hot water Storage: | No cylinder | |

## 6 Controls

| | | |
|---|---|---|
| Space heating controls | TTZC by plumbing and electrical services | OK |
| Hot water controls: | No cylinder | |
| | No cylinder | |
| Boiler interlock: | Yes | OK |

## 7 Low energy lights

| | | |
|---|---|---|
| Percentage of fixed lights with low-energy fittings | 100.0% | |
| Minimum | 75.0% | OK |

## 8 Mechanical ventilation

Not applicable

## 9 Summertime temperature

| | | |
|---|---|---|
| Overheating risk (East Pennines): | Slight | OK |

Based on:

| | |
|---|---|
| Overshading: | Average or unknown |
| Windows facing: South East | 0.66m² |
| Windows facing: South East | 3.16m² |
| Windows facing: South West | 0.66m² |
| Windows facing: North West | 0.66m² |
| Windows facing: North West | 1.26m² |
| Windows facing: South West | 1.1m² |
| Windows facing: North West | 3.15m² |
| Windows facing: South East | 1.1m² |
| Windows facing: South East | 1.44m² |
| Windows facing: South West | 0.66m² |
| Windows facing: North West | 1.44m² |
| Windows facing: North West | 1.44m² |
| Ventilation rate: | 3.00 |
| Blinds/curtains: | |
| | Closed 100% of daylight hours |

## 10 Key features

| | |
|---|---|
| Doors U-value | 1 W/m²K |
| Roofs U-value | 0.09 W/m²K |
| Party Walls U-value | 0 W/m²K |
| Floors U-value | 0.12 W/m²K |
| Photovoltaic array | |

# Thermal Bridge Report

## Property Details: Plot 156

| | |
|---|---|
| Address: | Plot 156, Land off Wardentree Lane, Spalding |
| Located in: | England |
| Region: | East Pennines |

## Thermal bridges:

Thermal bridges:

User-defined = UD
Default = D
Approved = A
User-defined (individual PSI-values) Y-Value = 0.0925

## External Junctions Details:

| Junction Type | PSI-Value | Length | Reference | Type |
|---|---|---|---|---|
| Steel lintel with perforated steel base plate | 0.5 | 12.37 | E1 | [A] |
| Sill | 0.04 | 9.86 | E3 | [A] |
| Jamb | 0.05 | 29.4 | E4 | [A] |
| Ground floor (normal) | 0.16 | 19.78 | E5 | [A] |
| Eaves (insulation at ceiling level) | 0.06 | 9.86 | E10 | [A] |
| Gable (insulation at ceiling level) | 0.24 | 9.92 | E12 | [A] |
| Corner (normal) | 0.09 | 15 | E16 | [A] |
| Intermediate floor within a dwelling | 0.07 | 19.78 | E6 | [A] |
| Corner (inverted internal area greater than external area) | -0.09 | 5 | E17 | [A] |
| Party wall between dwellings | 0.06 | 10 | E18 | [A] |

## Party Junctions Details:

| | | | | |
|---|---|---|---|---|
| Ground floor | 0 | 9.96 | P1 | [UD] |
| Intermediate floor within a dwelling | 0 | 9.96 | P2 | [UD] |
| Roof (insulation at ceiling level) | 0 | 9.96 | P4 | [UD] |

# SAP Input

## Property Details: Plot 156

| | |
|---|---|
| Address: | Plot 156, Land off Wardentree Lane, Spalding |
| Located in: | England |
| Region: | East Pennines |
| UPRN: | |
| Date of assessment: | Thursday, January 5, 2017 |
| Date of certificate: | Tuesday, January 10, 2017 |
| Assessment type: | New dwelling design stage |
| Transaction type: | New dwelling |
| Tenure type: | Unknown |
| Related party disclosure: | No related party |
| Thermal Mass Parameter: | Indicative Value Medium |
| Water use <= 125 litres/person/day: | True |
| PCDF Version: | 404 |

## Property description:

| | |
|---|---|
| Dwelling type: | House |
| Detachment: | Semi-detached |
| Year Completed: | 2017 |

| Floor Location: | Floor area: | Storey height: |
|---|---|---|
| Basement floor | 42.83 m² | 2.38 m |
| Floor 1 | 42.83 m² | 2.62 m |

| | |
|---|---|
| Living area: | 15.64 m² (fraction 0.183) |
| Front of dwelling faces: | South East |

## Opening types:

| Name: | Source: | Type: | Glazing: | Argon: | Frame: |
|---|---|---|---|---|---|
| Front Door | Manufacturer | Half glazed | low-E, En = 0.05, soft coat | Yes | PVC-U |
| Living Room 1 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Living Room 2 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Living Room 3 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Living Room 4 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Kitchen | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Dining | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Dining Doors | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| En Suite | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Bedroom 1 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Bathroom | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Bedroom 3 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Bedroom 2 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |

| **Name:** | **Gap:** | **Frame Factor:** | **g-value:** | **U-value:** | **Area:** | **No. of Openings:** |
|---|---|---|---|---|---|---|
| Front Door | 16mm or more mm | 0.7 | 0.63 | 1 | 2.12 | 1 |
| Living Room 1 | 16mm or more | 0.7 | 0.63 | 1.43 | 0.66 | 1 |
| Living Room 2 | 16mm or more | 0.7 | 0.63 | 1.43 | 3.16 | 1 |
| Living Room 3 | 16mm or more | 0.7 | 0.63 | 1.43 | 0.66 | 1 |
| Living Room 4 | 16mm or more | 0.7 | 0.63 | 1.43 | 0.66 | 1 |
| Kitchen | 16mm or more | 0.7 | 0.63 | 1.43 | 1.26 | 1 |
| Dining | 16mm or more | 0.7 | 0.63 | 1.43 | 1.1 | 1 |
| Dining Doors | 16mm or more | 0.7 | 0.63 | 1.43 | 3.15 | 1 |
| En Suite | 16mm or more | 0.7 | 0.63 | 1.43 | 1.1 | 1 |
| Bedroom 1 | 16mm or more | 0.7 | 0.63 | 1.43 | 1.44 | 1 |
| Bathroom | 16mm or more | 0.7 | 0.63 | 1.43 | 0.66 | 1 |
| Bedroom 3 | 16mm or more | 0.7 | 0.63 | 1.43 | 1.44 | 1 |
| Bedroom 2 | 16mm or more | 0.7 | 0.63 | 1.43 | 1.44 | 1 |

# SAP Input

| Name: | Type-Name: | Location: | Orient: | Width: | Height: |
|---|---|---|---|---|---|
| Front Door | | External Wall | South East | 1.01 | 2.1 |
| Living Room 1 | | External Wall | South East | 0.488 | 1.35 |
| Living Room 2 | | External Wall | South East | 2.339 | 1.35 |
| Living Room 3 | | External Wall | South West | 0.488 | 1.35 |
| Living Room 4 | | External Wall | North West | 0.63 | 1.05 |
| Kitchen | | External Wall | North West | 1.2 | 1.05 |
| Dining | | External Wall | South West | 0.915 | 1.2 |
| Dining Doors | | External Wall | North West | 1.5 | 2.1 |
| En Suite | | External Wall | South East | 0.915 | 1.2 |
| Bedroom 1 | | External Wall | South East | 1.2 | 1.2 |
| Bathroom | | External Wall | South West | 0.63 | 1.05 |
| Bedroom 3 | | External Wall | North West | 1.2 | 1.2 |
| Bedroom 2 | | External Wall | North West | 1.2 | 1.2 |

Overshading: Average or unknown

## Opaque Elements:

| Type: | Gross area: | Openings: | Net area: | U-value: | Ru value: | Curtain wall: | Kappa: |
|---|---|---|---|---|---|---|---|
| External Elements | | | | | | | |
| External Wall | 98.9 | 18.85 | 80.05 | 0.22 | 0 | False | N/A |
| Main Roof | 42.83 | 0 | 42.83 | 0.09 | 0 | | N/A |
| Ground Floor | 42.83 | | | 0.12 | | | N/A |
| Internal Elements | | | | | | | |
| Party Elements | | | | | | | |
| Party Wall | 49.8 | | | | | | N/A |

## Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0925

| | Length | Psi-value | | |
|---|---|---|---|---|
| [Approved] | 12.37 | 0.5 | E1 | Steel lintel with perforated steel base plate |
| [Approved] | 9.86 | 0.04 | E3 | Sill |
| [Approved] | 29.4 | 0.05 | E4 | Jamb |
| [Approved] | 19.78 | 0.16 | E5 | Ground floor (normal) |
| [Approved] | 9.86 | 0.06 | E10 | Eaves (insulation at ceiling level) |
| [Approved] | 9.92 | 0.24 | E12 | Gable (insulation at ceiling level) |
| [Approved] | 15 | 0.09 | E16 | Corner (normal) |
| [Approved] | 19.78 | 0.07 | E6 | Intermediate floor within a dwelling |
| [Approved] | 5 | -0.09 | E17 | Corner (inverted internal area greater than external area) |
| [Approved] | 10 | 0.06 | E18 | Party wall between dwellings |
| | 9.96 | 0 | P1 | Ground floor |
| | 9.96 | 0 | P2 | Intermediate floor within a dwelling |
| | 9.96 | 0 | P4 | Roof (insulation at ceiling level) |

## Ventilation:

| | |
|---|---|
| Pressure test: | Yes (As designed) |
| Ventilation: | Natural ventilation (extract fans) |
| Number of chimneys: | 0 |
| Number of open flues: | 0 |
| Number of fans: | 4 |
| Number of passive stacks: | 0 |
| Number of sides sheltered: | 0 |
| Pressure test: | 5 |

## Main heating system:

Main heating system: Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas

# SAP Input

| | |
|---|---|
| | Database: (rev 404, product index 017688) Efficiency: Winter 87.0 % Summer: 90.2<br>Brand name: Vaillant<br>Model: ecoTEC pro 30 H combi A<br>Model qualifier: VUW GB 306/5-3<br>(Combi boiler)<br>Systems with radiators<br>Central heating pump : 2013 or later<br>Design flow temperature: Unknown<br>Boiler interlock: Yes<br>Delayed start |
| **Main heating Control:** | |
| Main heating Control: | Time and temperature zone control by suitable arrangement of plumbing and electrical services<br>Control code: 2110 |
| **Secondary heating system:** | |
| Secondary heating system: | None |
| **Water heating:** | |
| Water heating: | From main heating system<br>Water code: 901<br>Fuel :mains gas<br>No hot water cylinder<br>Solar panel: False |
| **Others:** | |
| Electricity tariff: | Standard Tariff |
| In Smoke Control Area: | No |
| Conservatory: | No conservatory |
| Low energy lights: | 100% |
| Terrain type: | Low rise urban / suburban |
| EPC language: | English |
| Wind turbine: | No |
| Photovoltaics: | Photovoltaic 1<br>Installed Peak power: 1<br>Tilt of collector: 45°<br>Overshading: None or very little<br>Collector Orientation: South East |
| Assess Zero Carbon Home: | No |

# SAP WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Chloe Hewitt | **Stroma Number:** | STRO029693 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.5 |

## Property Address: Plot 156

**Address :** Plot 156, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 42.83 (1a) | x | 2.38 (2a) | = | 101.94 | (3a) |
| Ground floor | 42.83 (1b) | x | 2.62 (2b) | = | 112.21 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 85.66 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 214.15 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 4 | x 10 = | 40 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

| | | | Air changes per hour | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.19 (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | | 0 (9) |
| Additional infiltration | | [(9)-1]x0.1 = | 0 (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | | 0 (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | | 0 (12) |
| If no draught lobby, enter 0.05, else enter 0 | | | 0 (13) |
| Percentage of windows and doors draught stripped | | | 0 (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | | 0 (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | | 0 (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | | 5 (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | 0.44 (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 1 (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | | 0.44 (21) |

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

# SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.56 | 0.55 | 0.54 | 0.48 | 0.47 | 0.41 | 0.41 | 0.4 | 0.44 | 0.47 | 0.49 | 0.51 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

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

(24a)

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

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

(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.66 | 0.65 | 0.64 | 0.62 | 0.61 | 0.59 | 0.59 | 0.58 | 0.6 | 0.61 | 0.62 | 0.63 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.66 | 0.65 | 0.64 | 0.62 | 0.61 | 0.59 | 0.59 | 0.58 | 0.6 | 0.61 | 0.62 | 0.63 |

(25)

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2.12 | x | 1 | = | 2.12 | | | (26) |
| Windows Type 1 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 2 | | | 3.16 | x | 1/[1/( 1.43 )+ 0.04] | = | 4.27 | | | (27) |
| Windows Type 3 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 4 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 5 | | | 1.26 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.7 | | | (27) |
| Windows Type 6 | | | 1.1 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.49 | | | (27) |
| Windows Type 7 | | | 3.15 | x | 1/[1/( 1.43 )+ 0.04] | = | 4.26 | | | (27) |
| Windows Type 8 | | | 1.1 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.49 | | | (27) |
| Windows Type 9 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 10 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 11 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 12 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Floor | | | 42.83 | x | 0.12 | = | 5.1396 | | | (28) |
| Walls | 98.9 | 18.85 | 80.05 | x | 0.22 | = | 17.61 | | | (29) |
| Roof | 42.83 | 0 | 42.83 | x | 0.09 | = | 3.85 | | | (30) |
| Total area of elements, m² | | | 184.56 | | | | | | | (31) |

# SAP WorkSheet: New dwelling design stage

| | | | | | | |
|---|---|---|---|---|---|---|
| Party wall | 49.8 | x | 0 | = | 0 | (32) |

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

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

| | | | |
|---|---|---|---|
| Fabric heat loss, W/K = S (A x U) | (26)…(30) + (32) = | 51.35 | (33) |
| Heat capacity Cm = S(A x k ) | ((28)…(30) + (32) + (32a)…(32e) = | 10641.72 | (34) |
| Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K | Indicative Value: Medium | 250 | (35) |

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

| | | | |
|---|---|---|---|
| Thermal bridges : S (L x Y) calculated using Appendix K | | 17.07 | (36) |

*if details of thermal bridging are not known (36) = 0.15 x (31)*

| | | | |
|---|---|---|---|
| Total fabric heat loss | (33) + (36) = | 68.43 | (37) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 46.29 | 45.87 | 45.45 | 43.49 | 43.13 | 41.42 | 41.42 | 41.1 | 42.08 | 43.13 | 43.87 | 44.64 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 114.72 | 114.29 | 113.88 | 111.92 | 111.55 | 109.84 | 109.84 | 109.53 | 110.5 | 111.55 | 112.29 | 113.07 | |

Average = Sum(39)$_{1...12}$ /12= 111.92 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.34 | 1.33 | 1.33 | 1.31 | 1.3 | 1.28 | 1.28 | 1.28 | 1.29 | 1.3 | 1.31 | 1.32 | |

Average = Sum(40)$_{1...12}$ /12= 1.31 (40)

Number of days in month (Table 1a)

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

## 4. Water heating energy requirement: kWh/year:

| | | |
|---|---|---|
| Assumed occupancy, N<br>if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)<br>if TFA £ 13.9, N = 1 | 2.56 | (42) |
| Annual average hot water usage in litres per day Vd,average = (25 x N) + 36<br>*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)* | 95.04 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 104.54 | 100.74 | 96.94 | 93.14 | 89.33 | 85.53 | 85.53 | 89.33 | 93.14 | 96.94 | 100.74 | 104.54 | |

Total = Sum(44)$_{1...12}$ = 1140.44 (44)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 155.03 | 135.59 | 139.92 | 121.98 | 117.05 | 101 | 93.59 | 107.4 | 108.68 | 126.66 | 138.26 | 150.14 | |

Total = Sum(45)$_{1...12}$ = 1495.29 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.25 | 20.34 | 20.99 | 18.3 | 17.56 | 15.15 | 14.04 | 16.11 | 16.3 | 19 | 20.74 | 22.52 | (46) |

Water storage loss:

| | | |
|---|---|---|
| Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47) |

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

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

Water storage loss:

| | | |
|---|---|---|
| a) If manufacturer’s declared loss factor is known (kWh/day): | 0 | (48) |
| Temperature factor from Table 2b | 0 | (49) |

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| | | | |
|---|---|---|---|
| Energy lost from water storage, kWh/year | (48) x (49) = | 0 | (50) |
| b) If manufacturer's declared cylinder loss factor is not known: | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | 0 | (51) |
| If community heating see section 4.3 | | | |
| Volume factor from Table 2a | | 0 | (52) |
| Temperature factor from Table 2b | | 0 | (53) |
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 0 | (54) |
| Enter (50) or (54) in (55) | | 0 | (55) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3: 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 34.19 | 30.88 | 34.18 | 33.06 | 34.15 | 33.04 | 34.13 | 34.15 | 33.05 | 34.17 | 33.08 | 34.19 | (61) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 189.22 | 166.47 | 174.1 | 155.05 | 151.2 | 134.04 | 127.73 | 141.55 | 141.73 | 160.83 | 171.34 | 184.33 | (62) |

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 189.22 | 166.47 | 174.1 | 155.05 | 151.2 | 134.04 | 127.73 | 141.55 | 141.73 | 160.83 | 171.34 | 184.33 | |

Output from water heater (annual)$_{1...12}$: 1897.58 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 60.1 | 52.8 | 55.07 | 48.82 | 47.46 | 41.84 | 39.65 | 44.25 | 44.4 | 50.66 | 54.24 | 58.47 | (65) |

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

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 153.69 | 153.69 | 153.69 | 153.69 | 153.69 | 153.69 | 153.69 | 153.69 | 153.69 | 153.69 | 153.69 | 153.69 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 51.47 | 45.72 | 37.18 | 28.15 | 21.04 | 17.76 | 19.19 | 24.95 | 33.49 | 42.52 | 49.62 | 52.9 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 344.57 | 348.15 | 339.14 | 319.96 | 295.74 | 272.98 | 257.78 | 254.2 | 263.22 | 282.4 | 306.61 | 329.37 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 52.93 | 52.93 | 52.93 | 52.93 | 52.93 | 52.93 | 52.93 | 52.93 | 52.93 | 52.93 | 52.93 | 52.93 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | (71) |

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Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 80.77 | 78.58 | 74.01 | 67.81 | 63.79 | 58.12 | 53.3 | 59.47 | 61.67 | 68.09 | 75.33 | 78.59 | (72) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 583.98 | 579.6 | 557.49 | 523.08 | 487.73 | 456.02 | 437.43 | 445.79 | 465.53 | 500.16 | 538.73 | 568.02 | (73) |

## 6. Solar gains:

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

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 0.66 | x | 36.79 | x | 0.63 | x | 0.7 | = | 7.42 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 36.79 | x | 0.63 | x | 0.7 | = | 35.53 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 62.67 | x | 0.63 | x | 0.7 | = | 12.64 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 62.67 | x | 0.63 | x | 0.7 | = | 60.53 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 85.75 | x | 0.63 | x | 0.7 | = | 17.3 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 85.75 | x | 0.63 | x | 0.7 | = | 82.81 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 106.25 | x | 0.63 | x | 0.7 | = | 21.43 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 106.25 | x | 0.63 | x | 0.7 | = | 102.61 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 119.01 | x | 0.63 | x | 0.7 | = | 24 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 119.01 | x | 0.63 | x | 0.7 | = | 114.93 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 118.15 | x | 0.63 | x | 0.7 | = | 23.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 118.15 | x | 0.63 | x | 0.7 | = | 114.1 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 113.91 | x | 0.63 | x | 0.7 | = | 22.98 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 113.91 | x | 0.63 | x | 0.7 | = | 110.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 104.39 | x | 0.63 | x | 0.7 | = | 21.06 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 104.39 | x | 0.63 | x | 0.7 | = | 100.81 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 92.85 | x | 0.63 | x | 0.7 | = | 18.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 92.85 | x | 0.63 | x | 0.7 | = | 89.67 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 69.27 | x | 0.63 | x | 0.7 | = | 13.97 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 69.27 | x | 0.63 | x | 0.7 | = | 66.89 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 44.07 | x | 0.63 | x | 0.7 | = | 8.89 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 44.07 | x | 0.63 | x | 0.7 | = | 42.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 31.49 | x | 0.63 | x | 0.7 | = | 6.35 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 31.49 | x | 0.63 | x | 0.7 | = | 30.41 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 36.79 | | 0.63 | x | 0.7 | = | 12.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 62.67 | | 0.63 | x | 0.7 | = | 21.07 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 85.75 | | 0.63 | x | 0.7 | = | 28.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 106.25 | | 0.63 | x | 0.7 | = | 35.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 119.01 | | 0.63 | x | 0.7 | = | 40.01 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 118.15 | | 0.63 | x | 0.7 | = | 39.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 113.91 | | 0.63 | x | 0.7 | = | 38.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 104.39 | | 0.63 | x | 0.7 | = | 35.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | (79) |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 92.85 | | 0.63 | x | 0.7 | = | 31.21 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 69.27 | | 0.63 | x | 0.7 | = | 23.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 44.07 | | 0.63 | x | 0.7 | = | 14.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 31.49 | | 0.63 | x | 0.7 | = | 10.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | (79) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.34 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 11.28 | x | 0.63 | x | 0.7 | = | 10.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 22.97 | x | 0.63 | x | 0.7 | = | 8.84 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 22.97 | x | 0.63 | x | 0.7 | = | 22.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 41.38 | x | 0.63 | x | 0.7 | = | 15.93 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 41.38 | x | 0.63 | x | 0.7 | = | 39.83 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 67.96 | x | 0.63 | x | 0.7 | = | 26.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 67.96 | x | 0.63 | x | 0.7 | = | 65.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 91.35 | x | 0.63 | x | 0.7 | = | 35.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 91.35 | x | 0.63 | x | 0.7 | = | 87.94 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 97.38 | x | 0.63 | x | 0.7 | = | 37.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 97.38 | x | 0.63 | x | 0.7 | = | 93.75 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 97.38 | x | 0.63 | x | 0.7 | = | 42.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 97.38 | x | 0.63 | x | 0.7 | = | 42.86 | (81) |

# SAP WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | (81) |
| Northwest 0.9x | 0.77 | x | 1.26 | x | 91.1 | x | 0.63 | x | 0.7 | = | 35.08 | (81) |
| Northwest 0.9x | 0.77 | x | 3.15 | x | 91.1 | x | 0.63 | x | 0.7 | = | 87.7 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | (81) |
| Northwest 0.9x | 0.77 | x | 1.26 | x | 72.63 | x | 0.63 | x | 0.7 | = | 27.97 | (81) |
| Northwest 0.9x | 0.77 | x | 3.15 | x | 72.63 | x | 0.63 | x | 0.7 | = | 69.92 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | (81) |
| Northwest 0.9x | 0.77 | x | 1.26 | x | 50.42 | x | 0.63 | x | 0.7 | = | 19.42 | (81) |
| Northwest 0.9x | 0.77 | x | 3.15 | x | 50.42 | x | 0.63 | x | 0.7 | = | 48.54 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | (81) |
| Northwest 0.9x | 0.77 | x | 1.26 | x | 28.07 | x | 0.63 | x | 0.7 | = | 10.81 | (81) |
| Northwest 0.9x | 0.77 | x | 3.15 | x | 28.07 | x | 0.63 | x | 0.7 | = | 27.02 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | (81) |
| Northwest 0.9x | 0.77 | x | 1.26 | x | 14.2 | x | 0.63 | x | 0.7 | = | 5.47 | (81) |
| Northwest 0.9x | 0.77 | x | 3.15 | x | 14.2 | x | 0.63 | x | 0.7 | = | 13.67 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (81) |
| Northwest 0.9x | 0.77 | x | 1.26 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.55 | (81) |
| Northwest 0.9x | 0.77 | x | 3.15 | x | 9.21 | x | 0.63 | x | 0.7 | = | 8.87 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 126.14 | 223.97 | 330.63 | 450.21 | 541.28 | 553.64 | 526.99 | 456.57 | 371.65 | 254.06 | 152.75 | 106.88 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 710.12 | 803.57 | 888.13 | 973.29 | 1029 | 1009.66 | 964.42 | 902.35 | 837.18 | 754.22 | 691.48 | 674.9 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.99 | 0.99 | 0.97 | 0.93 | 0.82 | 0.65 | 0.49 | 0.54 | 0.78 | 0.95 | 0.99 | 0.99 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.72 | 19.89 | 20.16 | 20.52 | 20.8 | 20.95 | 20.99 | 20.98 | 20.88 | 20.52 | 20.06 | 19.69 | (87) |

# SAP WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.81 | 19.81 | 19.82 | 19.84 | 19.84 | 19.85 | 19.85 | 19.86 | 19.85 | 19.84 | 19.83 | 19.83 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.99 | 0.98 | 0.96 | 0.9 | 0.77 | 0.55 | 0.37 | 0.42 | 0.69 | 0.92 | 0.98 | 0.99 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.14 | 18.39 | 18.79 | 19.29 | 19.65 | 19.82 | 19.85 | 19.85 | 19.76 | 19.31 | 18.66 | 18.12 | (90) |

fLA = Living area ÷ (4) = 0.18 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.43 | 18.66 | 19.04 | 19.52 | 19.86 | 20.03 | 20.06 | 20.06 | 19.97 | 19.54 | 18.92 | 18.4 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.28 | 18.51 | 18.89 | 19.37 | 19.71 | 19.88 | 19.91 | 19.91 | 19.82 | 19.39 | 18.77 | 18.25 | (93) |

## 8. Space heating requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.99 | 0.97 | 0.95 | 0.89 | 0.76 | 0.55 | 0.37 | 0.42 | 0.69 | 0.91 | 0.97 | 0.99 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 699.51 | 782.75 | 843.22 | 862.75 | 779.75 | 559.89 | 360.93 | 379.92 | 578.04 | 685.45 | 672.89 | 666.64 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1603.47 | 1556.04 | 1410.59 | 1171.25 | 893.53 | 579.94 | 363.46 | 384.22 | 631.78 | 980.01 | 1309.99 | 1589.06 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 672.55 | 519.65 | 422.12 | 222.12 | 84.65 | 0 | 0 | 0 | 0 | 219.15 | 458.71 | 686.28 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3285.23 (98)

Space heating requirement in kWh/m²/year 38.35 (99)

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

**Space heating:**

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

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 90.2 (206)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | |
| | 672.55 | 519.65 | 422.12 | 222.12 | 84.65 | 0 | 0 | 0 | 0 | 219.15 | 458.71 | 686.28 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 745.62 | 576.11 | 467.98 | 246.26 | 93.85 | 0 | 0 | 0 | 0 | 242.96 | 508.55 | 760.84 | |

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3642.17 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

# SAP WorkSheet: New dwelling design stage

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 189.22 | 166.47 | 174.1 | 155.05 | 151.2 | 134.04 | 127.73 | 141.55 | 141.73 | 160.83 | 171.34 | 184.33 |

Efficiency of water heater: 87 (216)

(217)m= 89.48 | 89.4 | 89.24 | 88.86 | 88.12 | 87 | 87 | 87 | 87 | 88.82 | 89.31 | 89.5 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m= 211.48 | 186.21 | 195.08 | 174.49 | 171.58 | 154.07 | 146.81 | 162.7 | 162.91 | 181.08 | 191.85 | 205.95

Total = Sum(219a)$_{1...12}$ = 2144.21 (219)

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 3642.17 | |
| Water heating fuel used | | 2144.21 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | 75 | (231) |
| Electricity for lighting | | 363.6 | (232) |
| Electricity generated by PVs | | -803.2 | (233) |

## 10a. Fuel costs - individual heating systems:

| | **Fuel** kWh/year | **Fuel Price** (Table 12) | | **Fuel Cost** £/year | |
|---|---|---|---|---|---|
| Space heating - main system 1 | (211) x | 3.48 | x 0.01 = | 126.75 | (240) |
| Space heating - main system 2 | (213) x | 0 | x 0.01 = | 0 | (241) |
| Space heating - secondary | (215) x | 13.19 | x 0.01 = | 0 | (242) |
| Water heating cost (other fuel) | (219) | 3.48 | x 0.01 = | 74.62 | (247) |
| Pumps, fans and electric keep-hot | (231) | 13.19 | x 0.01 = | 9.89 | (249) |
| (if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a | | | | | |
| Energy for lighting | (232) | 13.19 | x 0.01 = | 47.96 | (250) |
| Additional standing charges (Table 12) | | | | 120 | (251) |
| | one of (233) to (235) x) | 13.19 | x 0.01 = | -105.94 | (252) |

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

**Total energy cost** (245)...(247) + (250)…(254) = 273.28 (255)

## 11a. SAP rating - individual heating systems

Energy cost deflator (Table 12): 0.42 (256)

Energy cost factor (ECF) [(255) x (256)] ÷ [(4) + 45.0] = 0.88 (257)

**SAP rating (Section 12)**: 87.75 (258)

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | **Emissions** kg CO2/year |
|---|---|---|---|

# SAP WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 786.71 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 463.15 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1249.86 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 188.71 | (268) |
| Energy saving/generation technologies Item 1 | | 0.519 | = | -416.86 | (269) |
| Total CO2, kg/year | sum of (265)…(271) = | | | 1060.63 | (272) |
| **CO2 emissions per m²** | (272) ÷ (4) = | | | 12.38 | (273) |
| EI rating (section 14) | | | | 89 | (274) |

## 13a. Primary Energy

| | **Energy** kWh/year | **Primary** factor | | **P. Energy** kWh/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 1.22 | = | 4443.44 | (261) |
| Space heating (secondary) | (215) x | 3.07 | = | 0 | (263) |
| Energy for water heating | (219) x | 1.22 | = | 2615.93 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 7059.38 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 3.07 | = | 230.25 | (267) |
| Electricity for lighting | (232) x | 0 | = | 1116.25 | (268) |
| Energy saving/generation technologies Item 1 | | 3.07 | = | -2465.81 | (269) |
| ‘Total Primary Energy | sum of (265)…(271) = | | | 5940.06 | (272) |
| **Primary energy kWh/m²/year** | (272) ÷ (4) = | | | 69.34 | (273) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Chloe Hewitt | **Stroma Number:** | STRO029693 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.5 |

## Property Address: Plot 156

**Address :** Plot 156, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 42.83 (1a) | x | 2.38 (2a) | = | 101.94 | (3a) |
| Ground floor | 42.83 (1b) | x | 2.62 (2b) | = | 112.21 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 85.66 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 214.15 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

| | | | Air changes per hour | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.14 (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | | 0 (9) |
| Additional infiltration | | [(9)-1]x0.1 = | 0 (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | | 0 (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | | 0 (12) |
| If no draught lobby, enter 0.05, else enter 0 | | | 0 (13) |
| Percentage of windows and doors draught stripped | | | 0 (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | | 0 (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | | 0 (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | | 5 (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | 0.39 (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 1 (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | | 0.39 (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | 0.49 | 0.48 | 0.43 | 0.42 | 0.37 | 0.37 | 0.36 | 0.39 | 0.42 | 0.44 | 0.46 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

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

(24a)

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

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

(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

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

(24d)

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

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

(25)

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2.12 | x | 1.2 | = | 2.544 | | | (26) |
| Windows Type 1 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 2 | | | 3.16 | x1/[1/( 1.4 )+ 0.04] | | = | 4.19 | | | (27) |
| Windows Type 3 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 4 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 5 | | | 1.26 | x1/[1/( 1.4 )+ 0.04] | | = | 1.67 | | | (27) |
| Windows Type 6 | | | 1.1 | x1/[1/( 1.4 )+ 0.04] | | = | 1.46 | | | (27) |
| Windows Type 7 | | | 3.15 | x1/[1/( 1.4 )+ 0.04] | | = | 4.18 | | | (27) |
| Windows Type 8 | | | 1.1 | x1/[1/( 1.4 )+ 0.04] | | = | 1.46 | | | (27) |
| Windows Type 9 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 10 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 11 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 12 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Floor | | | 42.83 | x | 0.13 | = | 5.5679 | | | (28) |
| Walls | 98.9 | 18.85 | 80.05 | x | 0.18 | = | 14.41 | | | (29) |
| Roof | 42.83 | 0 | 42.83 | x | 0.13 | = | 5.57 | | | (30) |
| Total area of elements, m² | | | 184.56 | | | | | | | (31) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | |
|---|---|---|---|---|---|---|
| Party wall | 49.8 | x | 0 | = | 0 | (32) |

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

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

| | | | |
|---|---|---|---|
| Fabric heat loss, W/K = S (A x U) | (26)…(30) + (32) = | 50.27 | (33) |
| Heat capacity Cm = S(A x k ) | ((28)…(30) + (32) + (32a)…(32e) = | 10641.72 | (34) |
| Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K | Indicative Value: Medium | 250 | (35) |

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

| | | | |
|---|---|---|---|
| Thermal bridges : S (L x Y) calculated using Appendix K | | 10.43 | (36) |

*if details of thermal bridging are not known (36) = 0.15 x (31)*

| | | | |
|---|---|---|---|
| Total fabric heat loss | (33) + (36) = | 60.69 | (37) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 44.08 | 43.74 | 43.4 | 41.84 | 41.55 | 40.19 | 40.19 | 39.94 | 40.71 | 41.55 | 42.14 | 42.76 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 104.77 | 104.43 | 104.1 | 102.53 | 102.24 | 100.88 | 100.88 | 100.63 | 101.41 | 102.24 | 102.83 | 103.45 | |

Average = Sum(39)$_{1...12}$ /12= 102.53 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.22 | 1.22 | 1.22 | 1.2 | 1.19 | 1.18 | 1.18 | 1.17 | 1.18 | 1.19 | 1.2 | 1.21 | |

Average = Sum(40)$_{1...12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

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

## 4. Water heating energy requirement: kWh/year:

| | | |
|---|---|---|
| Assumed occupancy, N<br>if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)<br>if TFA £ 13.9, N = 1 | 2.56 | (42) |
| Annual average hot water usage in litres per day Vd,average = (25 x N) + 36<br>*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)* | 95.04 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 104.54 | 100.74 | 96.94 | 93.14 | 89.33 | 85.53 | 85.53 | 89.33 | 93.14 | 96.94 | 100.74 | 104.54 | |

Total = Sum(44)$_{1...12}$ = 1140.44 (44)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 155.03 | 135.59 | 139.92 | 121.98 | 117.05 | 101 | 93.59 | 107.4 | 108.68 | 126.66 | 138.26 | 150.14 | |

Total = Sum(45)$_{1...12}$ = 1495.29 (45)

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

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

Water storage loss:

| | | |
|---|---|---|
| Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47) |

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

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

Water storage loss:

| | | |
|---|---|---|
| a) If manufacturer’s declared loss factor is known (kWh/day): | 0 | (48) |
| Temperature factor from Table 2b | 0 | (49) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Energy lost from water storage, kWh/year | (48) x (49) = | 0 | (50) |
| b) If manufacturer's declared cylinder loss factor is not known: | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | 0 | (51) |
| If community heating see section 4.3 | | | |
| Volume factor from Table 2a | | 0 | (52) |
| Temperature factor from Table 2b | | 0 | (53) |
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 0 | (54) |
| Enter (50) or (54) in (55) | | 0 | (55) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3: 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 131.78 | 115.25 | 118.93 | 103.69 | 99.49 | 85.85 | 79.55 | 91.29 | 92.38 | 107.66 | 117.52 | 127.62 | (62) |

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 131.78 | 115.25 | 118.93 | 103.69 | 99.49 | 85.85 | 79.55 | 91.29 | 92.38 | 107.66 | 117.52 | 127.62 | |

Output from water heater (annual)$_{1...12}$: 1271 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 32.94 | 28.81 | 29.73 | 25.92 | 24.87 | 21.46 | 19.89 | 22.82 | 23.09 | 26.91 | 29.38 | 31.9 | (65) |

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

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 20.59 | 18.29 | 14.87 | 11.26 | 8.42 | 7.11 | 7.68 | 9.98 | 13.39 | 17.01 | 19.85 | 21.16 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 230.86 | 233.26 | 227.22 | 214.37 | 198.15 | 182.9 | 172.71 | 170.32 | 176.35 | 189.21 | 205.43 | 220.68 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | (71) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 44.28 | 42.88 | 39.96 | 36 | 33.43 | 29.81 | 26.73 | 30.68 | 32.08 | 36.18 | 40.81 | 42.88 | (72) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 357.15 | 355.84 | 343.48 | 323.05 | 301.42 | 281.24 | 268.55 | 272.39 | 283.25 | 303.81 | 327.51 | 346.14 | (73) |

## 6. Solar gains:

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

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 0.66 | x | 36.79 | x | 0.63 | x | 0.7 | = | 7.42 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 36.79 | x | 0.63 | x | 0.7 | = | 35.53 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 62.67 | x | 0.63 | x | 0.7 | = | 12.64 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 62.67 | x | 0.63 | x | 0.7 | = | 60.53 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 85.75 | x | 0.63 | x | 0.7 | = | 17.3 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 85.75 | x | 0.63 | x | 0.7 | = | 82.81 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 106.25 | x | 0.63 | x | 0.7 | = | 21.43 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 106.25 | x | 0.63 | x | 0.7 | = | 102.61 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 119.01 | x | 0.63 | x | 0.7 | = | 24 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 119.01 | x | 0.63 | x | 0.7 | = | 114.93 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 118.15 | x | 0.63 | x | 0.7 | = | 23.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 118.15 | x | 0.63 | x | 0.7 | = | 114.1 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 113.91 | x | 0.63 | x | 0.7 | = | 22.98 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 113.91 | x | 0.63 | x | 0.7 | = | 110.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 104.39 | x | 0.63 | x | 0.7 | = | 21.06 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 104.39 | x | 0.63 | x | 0.7 | = | 100.81 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 92.85 | x | 0.63 | x | 0.7 | = | 18.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 92.85 | x | 0.63 | x | 0.7 | = | 89.67 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 69.27 | x | 0.63 | x | 0.7 | = | 13.97 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 69.27 | x | 0.63 | x | 0.7 | = | 66.89 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 44.07 | x | 0.63 | x | 0.7 | = | 8.89 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 44.07 | x | 0.63 | x | 0.7 | = | 42.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 31.49 | x | 0.63 | x | 0.7 | = | 6.35 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 31.49 | x | 0.63 | x | 0.7 | = | 30.41 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 36.79 | | 0.63 | x | 0.7 | = | 12.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 62.67 | | 0.63 | x | 0.7 | = | 21.07 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 85.75 | | 0.63 | x | 0.7 | = | 28.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 106.25 | | 0.63 | x | 0.7 | = | 35.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 119.01 | | 0.63 | x | 0.7 | = | 40.01 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 118.15 | | 0.63 | x | 0.7 | = | 39.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 113.91 | | 0.63 | x | 0.7 | = | 38.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 104.39 | | 0.63 | x | 0.7 | = | 35.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | (79) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 92.85 | | 0.63 | x | 0.7 | = | 31.21 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 69.27 | | 0.63 | x | 0.7 | = | 23.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 44.07 | | 0.63 | x | 0.7 | = | 14.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 31.49 | | 0.63 | x | 0.7 | = | 10.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | (79) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.34 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 11.28 | x | 0.63 | x | 0.7 | = | 10.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 22.97 | x | 0.63 | x | 0.7 | = | 8.84 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 22.97 | x | 0.63 | x | 0.7 | = | 22.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 41.38 | x | 0.63 | x | 0.7 | = | 15.93 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 41.38 | x | 0.63 | x | 0.7 | = | 39.83 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 67.96 | x | 0.63 | x | 0.7 | = | 26.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 67.96 | x | 0.63 | x | 0.7 | = | 65.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 91.35 | x | 0.63 | x | 0.7 | = | 35.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 91.35 | x | 0.63 | x | 0.7 | = | 87.94 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 97.38 | x | 0.63 | x | 0.7 | = | 37.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 97.38 | x | 0.63 | x | 0.7 | = | 93.75 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 97.38 | x | 0.63 | x | 0.7 | = | 42.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 97.38 | x | 0.63 | x | 0.7 | = | 42.86 | (81) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 91.1 | x | 0.63 | x | 0.7 | = | 35.08 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 91.1 | x | 0.63 | x | 0.7 | = | 87.7 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 72.63 | x | 0.63 | x | 0.7 | = | 27.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 72.63 | x | 0.63 | x | 0.7 | = | 69.92 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 50.42 | x | 0.63 | x | 0.7 | = | 19.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 50.42 | x | 0.63 | x | 0.7 | = | 48.54 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 28.07 | x | 0.63 | x | 0.7 | = | 10.81 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 28.07 | x | 0.63 | x | 0.7 | = | 27.02 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 14.2 | x | 0.63 | x | 0.7 | = | 5.47 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 14.2 | x | 0.63 | x | 0.7 | = | 13.67 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.55 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 9.21 | x | 0.63 | x | 0.7 | = | 8.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 126.14 | 223.97 | 330.63 | 450.21 | 541.28 | 553.64 | 526.99 | 456.57 | 371.65 | 254.06 | 152.75 | 106.88 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 483.3 | 579.82 | 674.11 | 773.26 | 842.69 | 834.87 | 795.54 | 728.96 | 654.9 | 557.87 | 480.25 | 453.02 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.96 | 0.88 | 0.71 | 0.54 | 0.61 | 0.86 | 0.98 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.63 | 19.8 | 20.09 | 20.46 | 20.77 | 20.94 | 20.99 | 20.98 | 20.85 | 20.44 | 19.97 | 19.61 | (87) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.9 | 19.9 | 19.91 | 19.92 | 19.93 | 19.94 | 19.94 | 19.94 | 19.93 | 19.93 | 19.92 | 19.91 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.94 | 0.83 | 0.62 | 0.42 | 0.48 | 0.79 | 0.97 | 1 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.65 | 18.83 | 19.11 | 19.49 | 19.77 | 19.91 | 19.93 | 19.93 | 19.85 | 19.48 | 19.01 | 18.64 | (90) |

fLA = Living area ÷ (4) = 0.18 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.83 | 19.01 | 19.29 | 19.66 | 19.95 | 20.1 | 20.13 | 20.13 | 20.03 | 19.65 | 19.18 | 18.82 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.83 | 19.01 | 19.29 | 19.66 | 19.95 | 20.1 | 20.13 | 20.13 | 20.03 | 19.65 | 19.18 | 18.82 | (93) |

## 8. Space heating requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.98 | 0.94 | 0.83 | 0.63 | 0.44 | 0.5 | 0.79 | 0.96 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 481.93 | 575.79 | 661.27 | 726.51 | 699.79 | 527.63 | 352.06 | 367.91 | 519.77 | 538.11 | 477.33 | 452.08 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1522.58 | 1473.51 | 1331.6 | 1103.76 | 843.76 | 554.86 | 355.81 | 374.86 | 601.52 | 925.42 | 1242.44 | 1512.15 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 774.24 | 603.27 | 498.73 | 271.61 | 107.11 | 0 | 0 | 0 | 0 | 288.16 | 550.88 | 788.69 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3882.7 (98)

Space heating requirement in kWh/m²/year 45.33 (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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10) | | | | | | | | | | | | | |
| (100)m= | 0 | 0 | 0 | 0 | 0 | 948.28 | 746.52 | 764.78 | 0 | 0 | 0 | 0 | (100) |
| Utilisation factor for loss hm | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.88 | 0.93 | 0.91 | 0 | 0 | 0 | 0 | (101) |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 832.56 | 696.2 | 693.74 | 0 | 0 | 0 | 0 | (102) |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 1071.83 | 1023.83 | 947.64 | 0 | 0 | 0 | 0 | (103) |
| *Space cooling requirement for month, whole dwelling, continuous ( kWh) = 0.024 x [(103)m – (102)m ] x (41)m* set (104)m to zero if (104)m < 3 × (98)m | | | | | | | | | | | | | |
| (104)m= | 0 | 0 | 0 | 0 | 0 | 172.27 | 243.76 | 188.9 | 0 | 0 | 0 | 0 | |

Total = Sum(104)$_{5,6,7,8}$ = 604.93 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (107)m= | 0 | 0 | 0 | 0 | 0 | 43.07 | 60.94 | 47.23 | 0 | 0 | 0 | 0 |

Total = Sum(107)$_{5..8}$ = 151.23 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.77 (108)

## 8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 47.09 (109)

**Target Fabric Energy Efficiency (TFEE)** 54.16 (109)

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Chloe Hewitt | **Stroma Number:** | STRO029693 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.5 |

## Property Address: Plot 156

**Address :** Plot 156, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 42.83 (1a) | x | 2.38 (2a) | = | 101.94 | (3a) |
| Ground floor | 42.83 (1b) | x | 2.62 (2b) | = | 112.21 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 85.66 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 214.15 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

| | | | Air changes per hour | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.14 (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | | 0 (9) |
| Additional infiltration | | [(9)-1]x0.1 = | 0 (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | | 0 (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | | 0 (12) |
| If no draught lobby, enter 0.05, else enter 0 | | | 0 (13) |
| Percentage of windows and doors draught stripped | | | 0 (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | | 0 (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | | 0 (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | | 5 (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | 0.39 (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 1 (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | | 0.39 (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | 0.49 | 0.48 | 0.43 | 0.42 | 0.37 | 0.37 | 0.36 | 0.39 | 0.42 | 0.44 | 0.46 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

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

(24a)

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

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

(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

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

(24d)

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

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

(25)

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2.12 | x | 1 | = | 2.12 | | | (26) |
| Windows Type 1 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 2 | | | 3.16 | x | 1/[1/( 1.43 )+ 0.04] | = | 4.27 | | | (27) |
| Windows Type 3 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 4 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 5 | | | 1.26 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.7 | | | (27) |
| Windows Type 6 | | | 1.1 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.49 | | | (27) |
| Windows Type 7 | | | 3.15 | x | 1/[1/( 1.43 )+ 0.04] | = | 4.26 | | | (27) |
| Windows Type 8 | | | 1.1 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.49 | | | (27) |
| Windows Type 9 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 10 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 11 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 12 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Floor | | | 42.83 | x | 0.12 | = | 5.1396 | | | (28) |
| Walls | 98.9 | 18.85 | 80.05 | x | 0.22 | = | 17.61 | | | (29) |
| Roof | 42.83 | 0 | 42.83 | x | 0.09 | = | 3.85 | | | (30) |
| Total area of elements, m² | | | 184.56 | | | | | | | (31) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | |
|---|---|---|---|---|---|---|
| Party wall | 49.8 | x | 0 | = | 0 | (32) |

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

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

| | | | |
|---|---|---|---|
| Fabric heat loss, W/K = S (A x U) | (26)…(30) + (32) = | 51.35 | (33) |
| Heat capacity Cm = S(A x k ) | ((28)…(30) + (32) + (32a)…(32e) = | 10641.72 | (34) |
| Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K | Indicative Value: Medium | 250 | (35) |

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

| | | | |
|---|---|---|---|
| Thermal bridges : S (L x Y) calculated using Appendix K | | 17.07 | (36) |

*if details of thermal bridging are not known (36) = 0.15 x (31)*

| | | | |
|---|---|---|---|
| Total fabric heat loss | (33) + (36) = | 68.43 | (37) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 44.08 | 43.74 | 43.4 | 41.84 | 41.55 | 40.19 | 40.19 | 39.94 | 40.71 | 41.55 | 42.14 | 42.76 | (38) |

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 112.5 | 112.16 | 111.83 | 110.27 | 109.97 | 108.61 | 108.61 | 108.36 | 109.14 | 109.97 | 110.57 | 111.18 | |

Average = Sum(39)$_{1...12}$ /12= 110.27 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.31 | 1.31 | 1.31 | 1.29 | 1.28 | 1.27 | 1.27 | 1.27 | 1.27 | 1.28 | 1.29 | 1.3 | |

Average = Sum(40)$_{1...12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

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

## 4. Water heating energy requirement: kWh/year:

| | | |
|---|---|---|
| Assumed occupancy, N<br>if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)<br>if TFA £ 13.9, N = 1 | 2.56 | (42) |
| Annual average hot water usage in litres per day Vd,average = (25 x N) + 36<br>*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)* | 95.04 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 104.54 | 100.74 | 96.94 | 93.14 | 89.33 | 85.53 | 85.53 | 89.33 | 93.14 | 96.94 | 100.74 | 104.54 | |

Total = Sum(44)$_{1...12}$ = 1140.44 (44)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 155.03 | 135.59 | 139.92 | 121.98 | 117.05 | 101 | 93.59 | 107.4 | 108.68 | 126.66 | 138.26 | 150.14 | |

Total = Sum(45)$_{1...12}$ = 1495.29 (45)

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

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

Water storage loss:

| | | |
|---|---|---|
| Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47) |

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

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

Water storage loss:

| | | |
|---|---|---|
| a) If manufacturer’s declared loss factor is known (kWh/day): | 0 | (48) |
| Temperature factor from Table 2b | 0 | (49) |

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| | | | |
|---|---|---|---|
| Energy lost from water storage, kWh/year | (48) x (49) = | 0 | (50) |
| b) If manufacturer's declared cylinder loss factor is not known: | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | 0 | (51) |
| If community heating see section 4.3 | | | |
| Volume factor from Table 2a | | 0 | (52) |
| Temperature factor from Table 2b | | 0 | (53) |
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 0 | (54) |
| Enter (50) or (54) in (55) | | 0 | (55) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3: 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 131.78 | 115.25 | 118.93 | 103.69 | 99.49 | 85.85 | 79.55 | 91.29 | 92.38 | 107.66 | 117.52 | 127.62 | (62) |

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 131.78 | 115.25 | 118.93 | 103.69 | 99.49 | 85.85 | 79.55 | 91.29 | 92.38 | 107.66 | 117.52 | 127.62 | |

Output from water heater (annual)$_{1...12}$: 1271 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 32.94 | 28.81 | 29.73 | 25.92 | 24.87 | 21.46 | 19.89 | 22.82 | 23.09 | 26.91 | 29.38 | 31.9 | (65) |

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

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 20.59 | 18.29 | 14.87 | 11.26 | 8.42 | 7.11 | 7.68 | 9.98 | 13.39 | 17.01 | 19.85 | 21.16 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 230.86 | 233.26 | 227.22 | 214.37 | 198.15 | 182.9 | 172.71 | 170.32 | 176.35 | 189.21 | 205.43 | 220.68 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | (71) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 44.28 | 42.88 | 39.96 | 36 | 33.43 | 29.81 | 26.73 | 30.68 | 32.08 | 36.18 | 40.81 | 42.88 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 357.15 | 355.84 | 343.48 | 323.05 | 301.42 | 281.24 | 268.55 | 272.39 | 283.25 | 303.81 | 327.51 | 346.14 | (73) |

## 6. Solar gains:

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

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 0.66 | x | 36.79 | x | 0.63 | x | 0.7 | = | 7.42 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 36.79 | x | 0.63 | x | 0.7 | = | 35.53 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 62.67 | x | 0.63 | x | 0.7 | = | 12.64 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 62.67 | x | 0.63 | x | 0.7 | = | 60.53 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 85.75 | x | 0.63 | x | 0.7 | = | 17.3 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 85.75 | x | 0.63 | x | 0.7 | = | 82.81 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 106.25 | x | 0.63 | x | 0.7 | = | 21.43 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 106.25 | x | 0.63 | x | 0.7 | = | 102.61 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 119.01 | x | 0.63 | x | 0.7 | = | 24 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 119.01 | x | 0.63 | x | 0.7 | = | 114.93 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 118.15 | x | 0.63 | x | 0.7 | = | 23.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 118.15 | x | 0.63 | x | 0.7 | = | 114.1 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 113.91 | x | 0.63 | x | 0.7 | = | 22.98 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 113.91 | x | 0.63 | x | 0.7 | = | 110.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 104.39 | x | 0.63 | x | 0.7 | = | 21.06 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 104.39 | x | 0.63 | x | 0.7 | = | 100.81 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |

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| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 92.85 | x | 0.63 | x | 0.7 | = | 18.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 92.85 | x | 0.63 | x | 0.7 | = | 89.67 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 69.27 | x | 0.63 | x | 0.7 | = | 13.97 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 69.27 | x | 0.63 | x | 0.7 | = | 66.89 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 44.07 | x | 0.63 | x | 0.7 | = | 8.89 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 44.07 | x | 0.63 | x | 0.7 | = | 42.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 31.49 | x | 0.63 | x | 0.7 | = | 6.35 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 31.49 | x | 0.63 | x | 0.7 | = | 30.41 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 36.79 | | 0.63 | x | 0.7 | = | 12.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 62.67 | | 0.63 | x | 0.7 | = | 21.07 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 85.75 | | 0.63 | x | 0.7 | = | 28.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 106.25 | | 0.63 | x | 0.7 | = | 35.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 119.01 | | 0.63 | x | 0.7 | = | 40.01 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 118.15 | | 0.63 | x | 0.7 | = | 39.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 113.91 | | 0.63 | x | 0.7 | = | 38.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 104.39 | | 0.63 | x | 0.7 | = | 35.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | (79) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 92.85 | | 0.63 | x | 0.7 | = | 31.21 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 69.27 | | 0.63 | x | 0.7 | = | 23.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 44.07 | | 0.63 | x | 0.7 | = | 14.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 31.49 | | 0.63 | x | 0.7 | = | 10.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | (79) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.34 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 11.28 | x | 0.63 | x | 0.7 | = | 10.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 22.97 | x | 0.63 | x | 0.7 | = | 8.84 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 22.97 | x | 0.63 | x | 0.7 | = | 22.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 41.38 | x | 0.63 | x | 0.7 | = | 15.93 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 41.38 | x | 0.63 | x | 0.7 | = | 39.83 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 67.96 | x | 0.63 | x | 0.7 | = | 26.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 67.96 | x | 0.63 | x | 0.7 | = | 65.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 91.35 | x | 0.63 | x | 0.7 | = | 35.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 91.35 | x | 0.63 | x | 0.7 | = | 87.94 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 97.38 | x | 0.63 | x | 0.7 | = | 37.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 97.38 | x | 0.63 | x | 0.7 | = | 93.75 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 97.38 | x | 0.63 | x | 0.7 | = | 42.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 97.38 | x | 0.63 | x | 0.7 | = | 42.86 | (81) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 91.1 | x | 0.63 | x | 0.7 | = | 35.08 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 91.1 | x | 0.63 | x | 0.7 | = | 87.7 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 72.63 | x | 0.63 | x | 0.7 | = | 27.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 72.63 | x | 0.63 | x | 0.7 | = | 69.92 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 50.42 | x | 0.63 | x | 0.7 | = | 19.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 50.42 | x | 0.63 | x | 0.7 | = | 48.54 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 28.07 | x | 0.63 | x | 0.7 | = | 10.81 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 28.07 | x | 0.63 | x | 0.7 | = | 27.02 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 14.2 | x | 0.63 | x | 0.7 | = | 5.47 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 14.2 | x | 0.63 | x | 0.7 | = | 13.67 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.55 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 9.21 | x | 0.63 | x | 0.7 | = | 8.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 126.14 | 223.97 | 330.63 | 450.21 | 541.28 | 553.64 | 526.99 | 456.57 | 371.65 | 254.06 | 152.75 | 106.88 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 483.3 | 579.82 | 674.11 | 773.26 | 842.69 | 834.87 | 795.54 | 728.96 | 654.9 | 557.87 | 480.25 | 453.02 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.96 | 0.89 | 0.74 | 0.58 | 0.64 | 0.87 | 0.98 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.51 | 19.69 | 19.98 | 20.37 | 20.71 | 20.92 | 20.98 | 20.97 | 20.81 | 20.36 | 19.87 | 19.49 | (87) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.83 | 19.83 | 19.84 | 19.85 | 19.85 | 19.87 | 19.87 | 19.87 | 19.86 | 19.85 | 19.85 | 19.84 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.95 | 0.85 | 0.64 | 0.44 | 0.5 | 0.81 | 0.97 | 1 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.48 | 18.66 | 18.95 | 19.34 | 19.66 | 19.83 | 19.86 | 19.86 | 19.75 | 19.34 | 18.85 | 18.47 | (90) |

fLA = Living area ÷ (4) = 0.18 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.67 | 18.85 | 19.14 | 19.53 | 19.85 | 20.03 | 20.07 | 20.06 | 19.95 | 19.53 | 19.04 | 18.65 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.67 | 18.85 | 19.14 | 19.53 | 19.85 | 20.03 | 20.07 | 20.06 | 19.95 | 19.53 | 19.04 | 18.65 | (93) |

## 8. Space heating requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.98 | 0.94 | 0.85 | 0.66 | 0.47 | 0.53 | 0.81 | 0.97 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 481.86 | 575.76 | 661.74 | 730.2 | 712.86 | 549.55 | 370.18 | 385.79 | 531.46 | 539.28 | 477.28 | 452.02 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1616.83 | 1564.78 | 1413.75 | 1172.34 | 896.19 | 589.46 | 376.38 | 396.77 | 637.91 | 982.04 | 1319.92 | 1607.15 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 844.42 | 664.62 | 559.49 | 318.34 | 136.39 | 0 | 0 | 0 | 0 | 329.41 | 606.7 | 859.42 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4318.79 (98)

Space heating requirement in kWh/m²/year 50.42 (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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10) | | | | | | | | | | | | | |
| (100)m= | 0 | 0 | 0 | 0 | 0 | 1020.97 | 803.74 | 823.55 | 0 | 0 | 0 | 0 | (100) |
| Utilisation factor for loss hm | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.84 | 0.91 | 0.88 | 0 | 0 | 0 | 0 | (101) |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 860.11 | 728.54 | 721.25 | 0 | 0 | 0 | 0 | (102) |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 1071.83 | 1023.83 | 947.64 | 0 | 0 | 0 | 0 | (103) |
| *Space cooling requirement for month, whole dwelling, continuous ( kWh) = 0.024 x [(103)m – (102)m ] x (41)m* set (104)m to zero if (104)m < 3 × (98)m | | | | | | | | | | | | | |
| (104)m= | 0 | 0 | 0 | 0 | 0 | 152.44 | 219.7 | 168.43 | 0 | 0 | 0 | 0 | |

Total = Sum(104)$_{5,6,7,8}$ = 540.57 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (107)m= | 0 | 0 | 0 | 0 | 0 | 38.11 | 54.93 | 42.11 | 0 | 0 | 0 | 0 |

Total = Sum(107)$_{5,8}$ = 135.14 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.58 (108)

## 8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 52 (109)

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Chloe Hewitt | **Stroma Number:** | STRO029693 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.5 |

## Property Address: Plot 156

**Address :** Plot 156, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 42.83 (1a) | x | 2.38 (2a) | = | 101.94 | (3a) |
| Ground floor | 42.83 (1b) | x | 2.62 (2b) | = | 112.21 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 85.66 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 214.15 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 4 | x 10 = | 40 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

| | | | Air changes per hour | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.19 (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | | 0 (9) |
| Additional infiltration | | [(9)-1]x0.1 = | 0 (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | | 0 (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | | 0 (12) |
| If no draught lobby, enter 0.05, else enter 0 | | | 0 (13) |
| Percentage of windows and doors draught stripped | | | 0 (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | | 0 (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | | 0 (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | | 5 (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | 0.44 (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 1 (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | | 0.44 (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

# DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.56 | 0.55 | 0.54 | 0.48 | 0.47 | 0.41 | 0.41 | 0.4 | 0.44 | 0.47 | 0.49 | 0.51 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

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

(24a)

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

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

(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.66 | 0.65 | 0.64 | 0.62 | 0.61 | 0.59 | 0.59 | 0.58 | 0.6 | 0.61 | 0.62 | 0.63 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.66 | 0.65 | 0.64 | 0.62 | 0.61 | 0.59 | 0.59 | 0.58 | 0.6 | 0.61 | 0.62 | 0.63 |

(25)

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2.12 | x | 1 | = | 2.12 | | | (26) |
| Windows Type 1 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 2 | | | 3.16 | x | 1/[1/( 1.43 )+ 0.04] | = | 4.27 | | | (27) |
| Windows Type 3 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 4 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 5 | | | 1.26 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.7 | | | (27) |
| Windows Type 6 | | | 1.1 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.49 | | | (27) |
| Windows Type 7 | | | 3.15 | x | 1/[1/( 1.43 )+ 0.04] | = | 4.26 | | | (27) |
| Windows Type 8 | | | 1.1 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.49 | | | (27) |
| Windows Type 9 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 10 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 11 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 12 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Floor | | | 42.83 | x | 0.12 | = | 5.1396 | | | (28) |
| Walls | 98.9 | 18.85 | 80.05 | x | 0.22 | = | 17.61 | | | (29) |
| Roof | 42.83 | 0 | 42.83 | x | 0.09 | = | 3.85 | | | (30) |
| Total area of elements, m² | | | 184.56 | | | | | | | (31) |

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| | | | | | | |
|---|---|---|---|---|---|---|
| Party wall | 49.8 | x | 0 | = | 0 | (32) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 51.35 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 10641.72 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 17.07 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 68.43 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 46.29 | 45.87 | 45.45 | 43.49 | 43.13 | 41.42 | 41.42 | 41.1 | 42.08 | 43.13 | 43.87 | 44.64 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 114.72 | 114.29 | 113.88 | 111.92 | 111.55 | 109.84 | 109.84 | 109.53 | 110.5 | 111.55 | 112.29 | 113.07 | |

Average = Sum(39)$_{1...12}$ /12= 111.92 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.34 | 1.33 | 1.33 | 1.31 | 1.3 | 1.28 | 1.28 | 1.28 | 1.29 | 1.3 | 1.31 | 1.32 | |

Average = Sum(40)$_{1...12}$ /12= 1.31 (40)

Number of days in month (Table 1a)

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

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.56 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 95.04 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | |
| (44)m= | 104.54 | 100.74 | 96.94 | 93.14 | 89.33 | 85.53 | 85.53 | 89.33 | 93.14 | 96.94 | 100.74 | 104.54 | |

Total = Sum(44)$_{1...12}$ = 1140.44 (44)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 155.03 | 135.59 | 139.92 | 121.98 | 117.05 | 101 | 93.59 | 107.4 | 108.68 | 126.66 | 138.26 | 150.14 | |

Total = Sum(45)$_{1...12}$ = 1495.29 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.25 | 20.34 | 20.99 | 18.3 | 17.56 | 15.15 | 14.04 | 16.11 | 16.3 | 19 | 20.74 | 22.52 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Energy lost from water storage, kWh/year | (48) x (49) = | 0 | (50) |
| b) If manufacturer's declared cylinder loss factor is not known: | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | 0 | (51) |
| If community heating see section 4.3 | | | |
| Volume factor from Table 2a | | 0 | (52) |
| Temperature factor from Table 2b | | 0 | (53) |
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 0 | (54) |
| Enter (50) or (54) in (55) | | 0 | (55) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3: 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 34.19 | 30.88 | 34.18 | 33.06 | 34.15 | 33.04 | 34.13 | 34.15 | 33.05 | 34.17 | 33.08 | 34.19 | (61) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 189.22 | 166.47 | 174.1 | 155.05 | 151.2 | 134.04 | 127.73 | 141.55 | 141.73 | 160.83 | 171.34 | 184.33 | (62) |

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 189.22 | 166.47 | 174.1 | 155.05 | 151.2 | 134.04 | 127.73 | 141.55 | 141.73 | 160.83 | 171.34 | 184.33 | |

Output from water heater (annual)$_{1...12}$: 1897.58 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 60.1 | 52.8 | 55.07 | 48.82 | 47.46 | 41.84 | 39.65 | 44.25 | 44.4 | 50.66 | 54.24 | 58.47 | (65) |

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

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 20.59 | 18.29 | 14.87 | 11.26 | 8.42 | 7.11 | 7.68 | 9.98 | 13.39 | 17.01 | 19.85 | 21.16 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 230.86 | 233.26 | 227.22 | 214.37 | 198.15 | 182.9 | 172.71 | 170.32 | 176.35 | 189.21 | 205.43 | 220.68 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | (71) |

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Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 80.77 | 78.58 | 74.01 | 67.81 | 63.79 | 58.12 | 53.3 | 59.47 | 61.67 | 68.09 | 75.33 | 78.59 | (72) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 396.65 | 394.55 | 380.53 | 357.86 | 334.77 | 312.54 | 298.11 | 304.19 | 315.84 | 338.72 | 365.04 | 384.85 | (73) |

## 6. Solar gains:

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

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 0.66 | x | 36.79 | x | 0.63 | x | 0.7 | = | 7.42 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 36.79 | x | 0.63 | x | 0.7 | = | 35.53 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 62.67 | x | 0.63 | x | 0.7 | = | 12.64 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 62.67 | x | 0.63 | x | 0.7 | = | 60.53 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 85.75 | x | 0.63 | x | 0.7 | = | 17.3 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 85.75 | x | 0.63 | x | 0.7 | = | 82.81 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 106.25 | x | 0.63 | x | 0.7 | = | 21.43 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 106.25 | x | 0.63 | x | 0.7 | = | 102.61 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 119.01 | x | 0.63 | x | 0.7 | = | 24 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 119.01 | x | 0.63 | x | 0.7 | = | 114.93 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 118.15 | x | 0.63 | x | 0.7 | = | 23.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 118.15 | x | 0.63 | x | 0.7 | = | 114.1 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 113.91 | x | 0.63 | x | 0.7 | = | 22.98 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 113.91 | x | 0.63 | x | 0.7 | = | 110.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 104.39 | x | 0.63 | x | 0.7 | = | 21.06 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 104.39 | x | 0.63 | x | 0.7 | = | 100.81 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 92.85 | x | 0.63 | x | 0.7 | = | 18.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 92.85 | x | 0.63 | x | 0.7 | = | 89.67 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 69.27 | x | 0.63 | x | 0.7 | = | 13.97 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 69.27 | x | 0.63 | x | 0.7 | = | 66.89 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 44.07 | x | 0.63 | x | 0.7 | = | 8.89 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 44.07 | x | 0.63 | x | 0.7 | = | 42.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 31.49 | x | 0.63 | x | 0.7 | = | 6.35 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 31.49 | x | 0.63 | x | 0.7 | = | 30.41 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 36.79 | | 0.63 | x | 0.7 | = | 12.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 62.67 | | 0.63 | x | 0.7 | = | 21.07 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 85.75 | | 0.63 | x | 0.7 | = | 28.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 106.25 | | 0.63 | x | 0.7 | = | 35.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 119.01 | | 0.63 | x | 0.7 | = | 40.01 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 118.15 | | 0.63 | x | 0.7 | = | 39.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 113.91 | | 0.63 | x | 0.7 | = | 38.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 104.39 | | 0.63 | x | 0.7 | = | 35.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | (79) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 92.85 | | 0.63 | x | 0.7 | = | 31.21 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 69.27 | | 0.63 | x | 0.7 | = | 23.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 44.07 | | 0.63 | x | 0.7 | = | 14.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 31.49 | | 0.63 | x | 0.7 | = | 10.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | (79) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.34 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 11.28 | x | 0.63 | x | 0.7 | = | 10.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 22.97 | x | 0.63 | x | 0.7 | = | 8.84 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 22.97 | x | 0.63 | x | 0.7 | = | 22.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 41.38 | x | 0.63 | x | 0.7 | = | 15.93 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 41.38 | x | 0.63 | x | 0.7 | = | 39.83 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 67.96 | x | 0.63 | x | 0.7 | = | 26.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 67.96 | x | 0.63 | x | 0.7 | = | 65.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 91.35 | x | 0.63 | x | 0.7 | = | 35.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 91.35 | x | 0.63 | x | 0.7 | = | 87.94 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 97.38 | x | 0.63 | x | 0.7 | = | 37.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 97.38 | x | 0.63 | x | 0.7 | = | 93.75 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 97.38 | x | 0.63 | x | 0.7 | = | 42.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 97.38 | x | 0.63 | x | 0.7 | = | 42.86 | (81) |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 91.1 | x | 0.63 | x | 0.7 | = | 35.08 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 91.1 | x | 0.63 | x | 0.7 | = | 87.7 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 72.63 | x | 0.63 | x | 0.7 | = | 27.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 72.63 | x | 0.63 | x | 0.7 | = | 69.92 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 50.42 | x | 0.63 | x | 0.7 | = | 19.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 50.42 | x | 0.63 | x | 0.7 | = | 48.54 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 28.07 | x | 0.63 | x | 0.7 | = | 10.81 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 28.07 | x | 0.63 | x | 0.7 | = | 27.02 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 14.2 | x | 0.63 | x | 0.7 | = | 5.47 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 14.2 | x | 0.63 | x | 0.7 | = | 13.67 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.55 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 9.21 | x | 0.63 | x | 0.7 | = | 8.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 126.14 | 223.97 | 330.63 | 450.21 | 541.28 | 553.64 | 526.99 | 456.57 | 371.65 | 254.06 | 152.75 | 106.88 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 522.79 | 618.52 | 711.16 | 808.07 | 876.05 | 866.18 | 825.1 | 760.76 | 687.49 | 592.78 | 517.78 | 491.73 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.99 | 0.96 | 0.88 | 0.73 | 0.56 | 0.63 | 0.86 | 0.98 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.52 | 19.7 | 19.99 | 20.38 | 20.72 | 20.92 | 20.98 | 20.97 | 20.82 | 20.38 | 19.89 | 19.5 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.81 | 19.81 | 19.82 | 19.84 | 19.84 | 19.85 | 19.85 | 19.86 | 19.85 | 19.84 | 19.83 | 19.83 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.94 | 0.83 | 0.63 | 0.43 | 0.49 | 0.79 | 0.96 | 0.99 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.86 | 18.12 | 18.55 | 19.11 | 19.56 | 19.8 | 19.85 | 19.85 | 19.7 | 19.12 | 18.4 | 17.84 | (90) |

fLA = Living area ÷ (4) = 0.18 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.16 | 18.41 | 18.81 | 19.35 | 19.77 | 20.01 | 20.05 | 20.05 | 19.91 | 19.35 | 18.67 | 18.14 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.01 | 18.26 | 18.66 | 19.2 | 19.62 | 19.86 | 19.9 | 19.9 | 19.76 | 19.2 | 18.52 | 17.99 | (93) |

## 8. Space heating requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.97 | 0.93 | 0.82 | 0.63 | 0.43 | 0.49 | 0.78 | 0.95 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 520.21 | 611.99 | 693.25 | 752.1 | 721.52 | 544.38 | 358.35 | 375.24 | 536.11 | 565.65 | 512.69 | 489.87 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1572.95 | 1526.82 | 1384.69 | 1152.28 | 883.86 | 577.47 | 363.01 | 383.43 | 624.91 | 959.5 | 1282.94 | 1559.37 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 783.24 | 614.76 | 514.43 | 288.13 | 120.78 | 0 | 0 | 0 | 0 | 293.03 | 554.58 | 795.71 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3964.66 (98)

Space heating requirement in kWh/m²/year 46.28 (99)

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

**Space heating:**

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

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 90.2 (206)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | |
| | 783.24 | 614.76 | 514.43 | 288.13 | 120.78 | 0 | 0 | 0 | 0 | 293.03 | 554.58 | 795.71 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 868.34 | 681.56 | 570.32 | 319.43 | 133.9 | 0 | 0 | 0 | 0 | 324.86 | 614.83 | 882.16 | |

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 4395.41 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

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**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 189.22 | 166.47 | 174.1 | 155.05 | 151.2 | 134.04 | 127.73 | 141.55 | 141.73 | 160.83 | 171.34 | 184.33 |

Efficiency of water heater: 87 (216)

(217)m= 89.56 | 89.5 | 89.37 | 89.05 | 88.39 | 87 | 87 | 87 | 87 | 89.04 | 89.42 | 89.58 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m= 211.28 | 186.01 | 194.81 | 174.1 | 171.05 | 154.07 | 146.81 | 162.7 | 162.91 | 180.62 | 191.6 | 205.77

Total = Sum(219a)$_{1...12}$ = 2141.74 (219)

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 4395.41 | |
| Water heating fuel used | | 2141.74 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | 75 | (231) |
| Electricity for lighting | | 363.6 | (232) |
| Electricity generated by PVs | | -803.2 | (233) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | | 0.216 | = | 949.41 | (261) |
| Space heating (secondary) | (215) x | | 0.519 | = | 0 | (263) |
| Water heating | (219) x | | 0.216 | = | 462.62 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 1412.02 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | | 0.519 | = | 188.71 | (268) |
| Energy saving/generation technologies Item 1 | | | 0.519 | = | -416.86 | (269) |
| Total CO2, kg/year | sum of (265)…(271) = | | | | 1222.8 | (272) |
| **Dwelling CO2 Emission Rate** | (272) ÷ (4) = | | | | 14.28 | (273) |
| EI rating (section 14) | | | | | 87 | (274) |

# TER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Chloe Hewitt | **Stroma Number:** | STRO029693 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.5 |

## Property Address: Plot 156

**Address :** Plot 156, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 42.83 (1a) | x | 2.38 (2a) | = | 101.94 | (3a) |
| Ground floor | 42.83 (1b) | x | 2.62 (2b) | = | 112.21 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 85.66 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 214.15 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

| | | | Air changes per hour | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.14 (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | | 0 (9) |
| Additional infiltration | | [(9)-1]x0.1 = | 0 (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | | 0 (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | | 0 (12) |
| If no draught lobby, enter 0.05, else enter 0 | | | 0 (13) |
| Percentage of windows and doors draught stripped | | | 0 (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | | 0 (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | | 0 (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | | 5 (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | 0.39 (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 1 (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | | 0.39 (21) |

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | 0.49 | 0.48 | 0.43 | 0.42 | 0.37 | 0.37 | 0.36 | 0.39 | 0.42 | 0.44 | 0.46 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

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

(24a)

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

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

(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

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

(24d)

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

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

(25)

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2.12 | x | 1.2 | = | 2.544 | | | (26) |
| Windows Type 1 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 2 | | | 3.16 | x1/[1/( 1.4 )+ 0.04] | | = | 4.19 | | | (27) |
| Windows Type 3 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 4 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 5 | | | 1.26 | x1/[1/( 1.4 )+ 0.04] | | = | 1.67 | | | (27) |
| Windows Type 6 | | | 1.1 | x1/[1/( 1.4 )+ 0.04] | | = | 1.46 | | | (27) |
| Windows Type 7 | | | 3.15 | x1/[1/( 1.4 )+ 0.04] | | = | 4.18 | | | (27) |
| Windows Type 8 | | | 1.1 | x1/[1/( 1.4 )+ 0.04] | | = | 1.46 | | | (27) |
| Windows Type 9 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 10 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 11 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 12 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Floor | | | 42.83 | x | 0.13 | = | 5.5679 | | | (28) |
| Walls | 98.9 | 18.85 | 80.05 | x | 0.18 | = | 14.41 | | | (29) |
| Roof | 42.83 | 0 | 42.83 | x | 0.13 | = | 5.57 | | | (30) |
| Total area of elements, m² | | | 184.56 | | | | | | | (31) |

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| | | | | | | |
|---|---|---|---|---|---|---|
| Party wall | 49.8 | x | 0 | = | 0 | (32) |

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

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

| | | |
|---|---|---|
| Fabric heat loss, W/K = S (A x U) | (26)…(30) + (32) = | 50.27 (33) |
| Heat capacity Cm = S(A x k ) | ((28)…(30) + (32) + (32a)…(32e) = | 10641.72 (34) |
| Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K | Indicative Value: Medium | 250 (35) |

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

| | | |
|---|---|---|
| Thermal bridges : S (L x Y) calculated using Appendix K | | 10.43 (36) |

*if details of thermal bridging are not known (36) = 0.15 x (31)*

| | | |
|---|---|---|
| Total fabric heat loss | (33) + (36) = | 60.69 (37) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 44.08 | 43.74 | 43.4 | 41.84 | 41.55 | 40.19 | 40.19 | 39.94 | 40.71 | 41.55 | 42.14 | 42.76 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 104.77 | 104.43 | 104.1 | 102.53 | 102.24 | 100.88 | 100.88 | 100.63 | 101.41 | 102.24 | 102.83 | 103.45 | |

Average = Sum(39)$_{1...12}$ /12= 102.53 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.22 | 1.22 | 1.22 | 1.2 | 1.19 | 1.18 | 1.18 | 1.17 | 1.18 | 1.19 | 1.2 | 1.21 | |

Average = Sum(40)$_{1...12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

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

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.56 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 95.04 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | |
| (44)m= | 104.54 | 100.74 | 96.94 | 93.14 | 89.33 | 85.53 | 85.53 | 89.33 | 93.14 | 96.94 | 100.74 | 104.54 | |

Total = Sum(44)$_{1...12}$ = 1140.44 (44)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 155.03 | 135.59 | 139.92 | 121.98 | 117.05 | 101 | 93.59 | 107.4 | 108.68 | 126.66 | 138.26 | 150.14 | |

Total = Sum(45)$_{1...12}$ = 1495.29 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.25 | 20.34 | 20.99 | 18.3 | 17.56 | 15.15 | 14.04 | 16.11 | 16.3 | 19 | 20.74 | 22.52 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

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| | | | |
|---|---|---|---|
| Energy lost from water storage, kWh/year | (48) x (49) = | 0 | (50) |
| b) If manufacturer's declared cylinder loss factor is not known: | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | 0 | (51) |
| If community heating see section 4.3 | | | |
| Volume factor from Table 2a | | 0 | (52) |
| Temperature factor from Table 2b | | 0 | (53) |
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 0 | (54) |
| Enter (50) or (54) in (55) | | 0 | (55) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3: 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 49.4 | 45.93 | 45.52 | 42.18 | 43.59 | 45.52 | 45.93 | 49.4 | 49.32 | 50.96 | (61) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 205.99 | 181.62 | 189.32 | 167.91 | 162.57 | 143.18 | 137.18 | 152.92 | 154.61 | 176.06 | 187.57 | 201.1 | (62) |

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 205.99 | 181.62 | 189.32 | 167.91 | 162.57 | 143.18 | 137.18 | 152.92 | 154.61 | 176.06 | 187.57 | 201.1 | |

Output from water heater (annual)$_{1...12}$: 2060.03 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 64.29 | 56.59 | 58.87 | 52.04 | 50.3 | 44.13 | 42.02 | 47.09 | 47.62 | 54.46 | 58.3 | 62.66 | (65) |

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

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | 128.08 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 20.59 | 18.29 | 14.87 | 11.26 | 8.42 | 7.11 | 7.68 | 9.98 | 13.39 | 17.01 | 19.85 | 21.16 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 230.86 | 233.26 | 227.22 | 214.37 | 198.15 | 182.9 | 172.71 | 170.32 | 176.35 | 189.21 | 205.43 | 220.68 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | 35.81 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | -102.46 | (71) |

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Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 86.41 | 84.21 | 79.13 | 72.28 | 67.61 | 61.29 | 56.47 | 63.29 | 66.14 | 73.2 | 80.97 | 84.22 | (72) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 402.28 | 400.18 | 385.65 | 362.33 | 338.59 | 315.72 | 301.29 | 308.01 | 320.31 | 343.84 | 370.67 | 390.48 | (73) |

## 6. Solar gains:

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

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 0.66 | x | 36.79 | x | 0.63 | x | 0.7 | = | 7.42 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 36.79 | x | 0.63 | x | 0.7 | = | 35.53 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 62.67 | x | 0.63 | x | 0.7 | = | 12.64 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 62.67 | x | 0.63 | x | 0.7 | = | 60.53 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 85.75 | x | 0.63 | x | 0.7 | = | 17.3 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 85.75 | x | 0.63 | x | 0.7 | = | 82.81 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 106.25 | x | 0.63 | x | 0.7 | = | 21.43 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 106.25 | x | 0.63 | x | 0.7 | = | 102.61 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 119.01 | x | 0.63 | x | 0.7 | = | 24 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 119.01 | x | 0.63 | x | 0.7 | = | 114.93 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 118.15 | x | 0.63 | x | 0.7 | = | 23.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 118.15 | x | 0.63 | x | 0.7 | = | 114.1 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 113.91 | x | 0.63 | x | 0.7 | = | 22.98 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 113.91 | x | 0.63 | x | 0.7 | = | 110.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 104.39 | x | 0.63 | x | 0.7 | = | 21.06 | (77) |
| Southeast 0.9x | 0.77 | x | 3.16 | x | 104.39 | x | 0.63 | x | 0.7 | = | 100.81 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 92.85 | x | 0.63 | x | 0.7 | = | 18.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 92.85 | x | 0.63 | x | 0.7 | = | 89.67 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 69.27 | x | 0.63 | x | 0.7 | = | 13.97 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 69.27 | x | 0.63 | x | 0.7 | = | 66.89 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 44.07 | x | 0.63 | x | 0.7 | = | 8.89 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 44.07 | x | 0.63 | x | 0.7 | = | 42.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.66 | x | 31.49 | x | 0.63 | x | 0.7 | = | 6.35 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.16 | x | 31.49 | x | 0.63 | x | 0.7 | = | 30.41 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 1.44 | x | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 36.79 | | 0.63 | x | 0.7 | = | 12.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 62.67 | | 0.63 | x | 0.7 | = | 21.07 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 85.75 | | 0.63 | x | 0.7 | = | 28.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 106.25 | | 0.63 | x | 0.7 | = | 35.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 119.01 | | 0.63 | x | 0.7 | = | 40.01 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 118.15 | | 0.63 | x | 0.7 | = | 39.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 113.91 | | 0.63 | x | 0.7 | = | 38.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 104.39 | | 0.63 | x | 0.7 | = | 35.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | (79) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 92.85 | | 0.63 | x | 0.7 | = | 31.21 | | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 69.27 | | 0.63 | x | 0.7 | = | 23.29 | | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 44.07 | | 0.63 | x | 0.7 | = | 14.82 | | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 31.49 | | 0.63 | x | 0.7 | = | 10.59 | | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | | (79) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.34 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 11.28 | x | 0.63 | x | 0.7 | = | 10.86 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 22.97 | x | 0.63 | x | 0.7 | = | 8.84 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 22.97 | x | 0.63 | x | 0.7 | = | 22.11 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 41.38 | x | 0.63 | x | 0.7 | = | 15.93 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 41.38 | x | 0.63 | x | 0.7 | = | 39.83 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 67.96 | x | 0.63 | x | 0.7 | = | 26.17 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 67.96 | x | 0.63 | x | 0.7 | = | 65.42 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 91.35 | x | 0.63 | x | 0.7 | = | 35.17 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 91.35 | x | 0.63 | x | 0.7 | = | 87.94 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.26 | x | 97.38 | x | 0.63 | x | 0.7 | = | 37.5 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.15 | x | 97.38 | x | 0.63 | x | 0.7 | = | 93.75 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 97.38 | x | 0.63 | x | 0.7 | = | 42.86 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 97.38 | x | 0.63 | x | 0.7 | = | 42.86 | | (81) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | (81) |
| Northwest 0.9x | 0.77 | x | 1.26 | x | 91.1 | x | 0.63 | x | 0.7 | = | 35.08 | (81) |
| Northwest 0.9x | 0.77 | x | 3.15 | x | 91.1 | x | 0.63 | x | 0.7 | = | 87.7 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | (81) |
| Northwest 0.9x | 0.77 | x | 1.26 | x | 72.63 | x | 0.63 | x | 0.7 | = | 27.97 | (81) |
| Northwest 0.9x | 0.77 | x | 3.15 | x | 72.63 | x | 0.63 | x | 0.7 | = | 69.92 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | (81) |
| Northwest 0.9x | 0.77 | x | 1.26 | x | 50.42 | x | 0.63 | x | 0.7 | = | 19.42 | (81) |
| Northwest 0.9x | 0.77 | x | 3.15 | x | 50.42 | x | 0.63 | x | 0.7 | = | 48.54 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | (81) |
| Northwest 0.9x | 0.77 | x | 1.26 | x | 28.07 | x | 0.63 | x | 0.7 | = | 10.81 | (81) |
| Northwest 0.9x | 0.77 | x | 3.15 | x | 28.07 | x | 0.63 | x | 0.7 | = | 27.02 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | (81) |
| Northwest 0.9x | 0.77 | x | 1.26 | x | 14.2 | x | 0.63 | x | 0.7 | = | 5.47 | (81) |
| Northwest 0.9x | 0.77 | x | 3.15 | x | 14.2 | x | 0.63 | x | 0.7 | = | 13.67 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (81) |
| Northwest 0.9x | 0.77 | x | 1.26 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.55 | (81) |
| Northwest 0.9x | 0.77 | x | 3.15 | x | 9.21 | x | 0.63 | x | 0.7 | = | 8.87 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 126.14 | 223.97 | 330.63 | 450.21 | 541.28 | 553.64 | 526.99 | 456.57 | 371.65 | 254.06 | 152.75 | 106.88 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 528.42 | 624.15 | 716.28 | 812.54 | 879.87 | 869.35 | 828.28 | 764.58 | 691.96 | 597.9 | 523.42 | 497.36 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.99 | 0.95 | 0.86 | 0.69 | 0.52 | 0.58 | 0.84 | 0.97 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.68 | 19.85 | 20.13 | 20.49 | 20.79 | 20.95 | 20.99 | 20.98 | 20.87 | 20.48 | 20.01 | 19.65 | (87) |

# TER WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.9 | 19.9 | 19.91 | 19.92 | 19.93 | 19.94 | 19.94 | 19.94 | 19.93 | 19.93 | 19.92 | 19.91 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.93 | 0.81 | 0.6 | 0.4 | 0.46 | 0.76 | 0.96 | 0.99 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.15 | 18.4 | 18.81 | 19.33 | 19.72 | 19.91 | 19.93 | 19.93 | 19.83 | 19.32 | 18.65 | 18.12 | (90) |

fLA = Living area ÷ (4) = 0.18 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.43 | 18.67 | 19.05 | 19.54 | 19.92 | 20.1 | 20.13 | 20.12 | 20.02 | 19.53 | 18.9 | 18.4 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.43 | 18.67 | 19.05 | 19.54 | 19.92 | 20.1 | 20.13 | 20.12 | 20.02 | 19.53 | 18.9 | 18.4 | (93) |

## 8. Space heating requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.97 | 0.93 | 0.81 | 0.61 | 0.43 | 0.48 | 0.77 | 0.95 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 525.96 | 617.65 | 697.73 | 752.53 | 712.81 | 530.94 | 352.62 | 369.09 | 530.55 | 569.38 | 518.37 | 495.6 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1479.94 | 1437.69 | 1306.23 | 1091.31 | 840.08 | 554.42 | 355.78 | 374.82 | 600.1 | 913.11 | 1213.25 | 1468.93 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 709.76 | 551.06 | 452.73 | 243.92 | 94.68 | 0 | 0 | 0 | 0 | 255.74 | 500.32 | 724.16 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3532.37 (98)

Space heating requirement in kWh/m²/year 41.24 (99)

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

**Space heating:**

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

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 93.4 (206)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | |
| | 709.76 | 551.06 | 452.73 | 243.92 | 94.68 | 0 | 0 | 0 | 0 | 255.74 | 500.32 | 724.16 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 759.92 | 590 | 484.72 | 261.16 | 101.38 | 0 | 0 | 0 | 0 | 273.81 | 535.67 | 775.33 | |

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3781.98 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

# TER WorkSheet: New dwelling design stage

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 205.99 | 181.62 | 189.32 | 167.91 | 162.57 | 143.18 | 137.18 | 152.92 | 154.61 | 176.06 | 187.57 | 201.1 |

Efficiency of water heater: 80.3 (216)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 87.91 | 87.67 | 87.17 | 85.99 | 83.74 | 80.3 | 80.3 | 80.3 | 80.3 | 85.99 | 87.4 | 87.99 |

(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 234.31 | 207.17 | 217.19 | 195.27 | 194.13 | 178.31 | 170.83 | 190.44 | 192.54 | 204.74 | 214.61 | 228.53 |

Total = Sum(219a)$_{1...12}$ = 2428.07 (219)

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 3781.98 | |
| Water heating fuel used | | 2428.07 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | 75 | (231) |
| Electricity for lighting | | 363.6 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 816.91 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 524.46 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1341.37 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 188.71 | (268) |
| Total CO2, kg/year | sum of (265)…(271) = | | | 1569 | (272) |

**TER =** 18.32 (273)

# SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on Tuesday, January 10, 2017

## Property Details: Plot 156

| | |
|---|---|
| **Dwelling type:** | Semi-detached House |
| **Located in:** | England |
| **Region:** | East Pennines |
| **Cross ventilation possible:** | Yes |
| **Number of storeys:** | 2 |
| **Front of dwelling faces:** | South East |
| **Overshading:** | Average or unknown |
| **Overhangs:** | None |
| **Thermal mass parameter:** | Indicative Value Medium |
| **Night ventilation:** | False |
| **Blinds, curtains, shutters:** | |
| **Ventilation rate during hot weather (ach):** | 3 ( Windows open half the time) |

## Overheating Details:

| | | |
|---|---|---|
| **Summer ventilation heat loss coefficient:** | 212.01 | **(P1)** |
| **Transmission heat loss coefficient:** | 68.4 | |
| **Summer heat loss coefficient:** | 280.43 | **(P2)** |

## Overhangs:

| Orientation: | Ratio: | Z_overhangs: |
|---|---|---|
| South East (Living Room 1) | 0 | 1 |
| South East (Living Room 2) | 0 | 1 |
| South West (Living Room 3) | 0 | 1 |
| North West (Living Room 4) | 0 | 1 |
| North West (Kitchen) | 0 | 1 |
| South West (Dining) | 0 | 1 |
| North West (Dining Doors) | 0 | 1 |
| South East (En Suite) | 0 | 1 |
| South East (Bedroom 1) | 0 | 1 |
| South West (Bathroom) | 0 | 1 |
| North West (Bedroom 3) | 0 | 1 |
| North West (Bedroom 2) | 0 | 1 |

## Solar shading:

| Orientation: | Z blinds: | Solar access: | Overhangs: | Z summer: | |
|---|---|---|---|---|---|
| South East (Living Room 1) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South East (Living Room 2) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South West (Living Room 3) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (Living Room 4) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (Kitchen) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South West (Dining) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (Dining Doors) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South East (En Suite) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South East (Bedroom 1) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South West (Bathroom) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (Bedroom 3) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (Bedroom 2) | 1 | 0.9 | 1 | 0.9 | **(P8)** |

## Solar gains:

| Orientation | Area | Flux | g_ | FF | Shading | Gains |
|---|---|---|---|---|---|---|

# SAP 2012 Overheating Assessment

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| South East (Living Room 1) | 0.9 x | 0.66 | 113.91 | 0.63 | 0.7 | 0.9 | 26.86 | |
| South East (Living Room 2) | 0.9 x | 3.16 | 113.91 | 0.63 | 0.7 | 0.9 | 128.58 | |
| South West (Living Room 3) | 0.9 x | 0.66 | 113.91 | 0.63 | 0.7 | 0.9 | 26.86 | |
| North West (Living Room 4) | 0.9 x | 0.66 | 91.1 | 0.63 | 0.7 | 0.9 | 21.48 | |
| North West (Kitchen) | 0.9 x | 1.26 | 91.1 | 0.63 | 0.7 | 0.9 | 41 | |
| South West (Dining) | 0.9 x | 1.1 | 113.91 | 0.63 | 0.7 | 0.9 | 44.76 | |
| North West (Dining Doors) | 0.9 x | 3.15 | 91.1 | 0.63 | 0.7 | 0.9 | 102.51 | |
| South East (En Suite) | 0.9 x | 1.1 | 113.91 | 0.63 | 0.7 | 0.9 | 44.76 | |
| South East (Bedroom 1) | 0.9 x | 1.44 | 113.91 | 0.63 | 0.7 | 0.9 | 58.59 | |
| South West (Bathroom) | 0.9 x | 0.66 | 113.91 | 0.63 | 0.7 | 0.9 | 26.86 | |
| North West (Bedroom 3) | 0.9 x | 1.44 | 91.1 | 0.63 | 0.7 | 0.9 | 46.86 | |
| North West (Bedroom 2) | 0.9 x | 1.44 | 91.1 | 0.63 | 0.7 | 0.9 | 46.86 | |
| | | | | | | **Total** | 615.96 | **(P3/P4)** |

## Internal gains:

| | **June** | **July** | **August** | |
|---|---|---|---|---|
| Internal gains | 453.02 | 434.43 | 442.79 | |
| Total summer gains | 1100.13 | 1050.4 | 976.43 | **(P5)** |
| Summer gain/loss ratio | 3.92 | 3.75 | 3.48 | **(P6)** |
| Mean summer external temperature (East Pennines) | 14.6 | 16.6 | 16.4 | |
| Thermal mass temperature increment | 0.25 | 0.25 | 0.25 | |
| Threshold temperature | 18.77 | 20.6 | 20.13 | **(P7)** |
| **Likelihood of high internal temperature** | **Not significant** | **Slight** | **Not significant** | |

**Assessment of likelihood of high internal temperature:** Slight