# 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 12:02:57 PM*

## Project Information:

**Assessed By:** Chloe Hewitt (STRO029693) **Building Type:** Detached House

## Dwelling Details:

**NEW DWELLING DESIGN STAGE** Total Floor Area: 91.5m²
**Site Reference :** Wardentree Lane **Plot Reference:** Plot 57
**Address :** Plot 57 , 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) | 17.07 kg/m² | |
| Dwelling Carbon Dioxide Emission Rate (DER) | 13.50 kg/m² | **OK** |

## 1b TFEE and DFEE

| | | |
|---|---|---|
| Target Fabric Energy Efficiency (TFEE) | 49.6 kWh/m² | |
| Dwelling Fabric Energy Efficiency (DFEE) | 48.8 kWh/m² | |
| | | **OK** |

## 2 Fabric U-values

| Element | Average | Highest | |
|---|---|---|---|
| External wall | 0.22 (max. 0.30) | 0.22 (max. 0.70) | **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 | 1.39 (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 West | 1.62m² |
| Windows facing: South West | 1.62m² |
| Windows facing: South West | 0.66m² |
| Windows facing: South East | 3.38m² |
| Windows facing: North East | 0.66m² |
| Windows facing: North West | 1.26m² |
| Windows facing: North West | 2.52m² |
| Windows facing: South West | 1.44m² |
| Windows facing: South West | 0.66m² |
| Windows facing: South West | 1.44m² |
| Windows facing: South East | 1.1m² |
| Windows facing: South East | 1.1m² |
| 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 |
| Floors U-value | 0.12 W/m²K |
| Photovoltaic array | |

# Thermal Bridge Report

## Property Details: Plot 57

| | |
|---|---|
| Address: | Plot 57 , 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 = 0.1203

## External Junctions Details:

| Junction Type | PSI-Value | Length | Reference | Type |
|---|---|---|---|---|
| Steel lintel with perforated steel base plate | 0.5 | 13.95 | E1 | [A] |
| Sill | 0.04 | 11.74 | E3 | [A] |
| Jamb | 0.05 | 32.1 | E4 | [A] |
| Ground floor (normal) | 0.16 | 27.46 | E5 | [A] |
| Eaves (insulation at ceiling level) | 0.06 | 19.33 | E10 | [A] |
| Gable (insulation at ceiling level) | 0.24 | 11.37 | E12 | [A] |
| Corner (normal) | 0.09 | 20 | E16 | [A] |
| Intermediate floor within a dwelling | 0.07 | 20 | E6 | [A] |

# SAP Input

## Property Details: Plot 57

| | |
|---|---|
| Address: | Plot 57 , 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: | Detached |
| Year Completed: | 2017 |

| Floor Location: | Floor area: | Storey height: |
|---|---|---|
| Basement floor | 45.75 m² | 2.38 m |
| Floor 1 | 45.75 m² | 2.62 m |

| | |
|---|---|
| Living area: | 18.18 m² (fraction 0.199) |
| Front of dwelling faces: | South West |

## Opening types:

| Name: | Source: | Type: | Glazing: | Argon: | Frame: |
|---|---|---|---|---|---|
| Front Door | Manufacturer | Half glazed | low-E, En = 0.05, soft coat | Yes | PVC-U |
| Dining | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Living Room | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Living Bay 1 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Living Bay 2 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Living Bay 3 | 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 | |
| Bedroom 2 | 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 | |
| Bedroom 1 2 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Bath | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| Bedroom 3 | 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 |
| Dining | 16mm or more | 0.7 | 0.63 | 1.43 | 1.62 | 1 |
| Living Room | 16mm or more | 0.7 | 0.63 | 1.43 | 1.62 | 1 |
| Living Bay 1 | 16mm or more | 0.7 | 0.63 | 1.43 | 0.66 | 1 |
| Living Bay 2 | 16mm or more | 0.7 | 0.63 | 1.43 | 3.38 | 1 |
| Living Bay 3 | 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 | 2.52 | 1 |
| Bedroom 2 | 16mm or more | 0.7 | 0.63 | 1.43 | 1.44 | 1 |
| En Suite | 16mm or more | 0.7 | 0.63 | 1.43 | 0.66 | 1 |
| Bedroom 1 | 16mm or more | 0.7 | 0.63 | 1.43 | 1.44 | 1 |
| Bedroom 1 2 | 16mm or more | 0.7 | 0.63 | 1.43 | 1.1 | 1 |

# SAP Input

| | | | | | | |
|---|---|---|---|---|---|---|
| Bath | 16mm or more | 0.7 | 0.63 | 1.43 | 1.1 | 1 |
| Bedroom 3 | 16mm or more | 0.7 | 0.63 | 1.43 | 1.44 | 1 |

| Name: | Type-Name: | Location: | Orient: | Width: | Height: |
|---|---|---|---|---|---|
| Front Door | | External Wall | South West | 1.01 | 2.1 |
| Dining | | External Wall | South West | 1.2 | 1.35 |
| Living Room | | External Wall | South West | 1.2 | 1.35 |
| Living Bay 1 | | External Wall | South West | 0.488 | 1.35 |
| Living Bay 2 | | External Wall | South East | 2.5 | 1.35 |
| Living Bay 3 | | External Wall | North East | 0.488 | 1.35 |
| Kitchen | | External Wall | North West | 1.2 | 1.05 |
| Dining | | External Wall | North West | 1.2 | 2.1 |
| Bedroom 2 | | External Wall | South West | 1.2 | 1.2 |
| En Suite | | External Wall | South West | 0.63 | 1.05 |
| Bedroom 1 | | External Wall | South West | 1.2 | 1.2 |
| Bedroom 1 2 | | External Wall | South East | 0.915 | 1.2 |
| Bath | | External Wall | South East | 0.915 | 1.2 |
| Bedroom 3 | | 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 | 78 | 21.02 | 56.98 | 0.22 | 0 | False | N/A |
| Main Roof | 46.94 | 0 | 46.94 | 0.09 | 0 | | N/A |
| Ground Floor | 45.75 | | | 0.12 | | | N/A |
| Internal Elements | | | | | | | |
| Party Elements | | | | | | | |

## Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.1203

| | Length | Psi-value | | |
|---|---|---|---|---|
| [Approved] | 13.95 | 0.5 | E1 | Steel lintel with perforated steel base plate |
| [Approved] | 11.74 | 0.04 | E3 | Sill |
| [Approved] | 32.1 | 0.05 | E4 | Jamb |
| [Approved] | 27.46 | 0.16 | E5 | Ground floor (normal) |
| [Approved] | 19.33 | 0.06 | E10 | Eaves (insulation at ceiling level) |
| [Approved] | 11.37 | 0.24 | E12 | Gable (insulation at ceiling level) |
| [Approved] | 20 | 0.09 | E16 | Corner (normal) |
| [Approved] | 20 | 0.07 | E6 | Intermediate floor within a dwelling |

## 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
Info Source: Boiler Database

# 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 West |
| 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 57

**Address :** Plot 57 , Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 45.75 (1a) | x | 2.38 (2a) | = | 108.89 | (3a) |
| Ground floor | 45.75 (1b) | x | 2.62 (2b) | = | 119.86 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 91.5 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 228.75 | (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) = | 0.17 | (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) | | | 0.42 | (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) = | 0.42 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.54 | 0.53 | 0.52 | 0.47 | 0.46 | 0.4 | 0.4 | 0.39 | 0.42 | 0.46 | 0.48 | 0.5 |

*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= | 0.65 | 0.64 | 0.64 | 0.61 | 0.6 | 0.58 | 0.58 | 0.58 | 0.59 | 0.6 | 0.61 | 0.62 | (24d) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.65 | 0.64 | 0.64 | 0.61 | 0.6 | 0.58 | 0.58 | 0.58 | 0.59 | 0.6 | 0.61 | 0.62 | (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 | | | 1.62 | x | 1/[1/( 1.43 )+ 0.04] | = | 2.19 | | | (27) |
| Windows Type 2 | | | 1.62 | x | 1/[1/( 1.43 )+ 0.04] | = | 2.19 | | | (27) |
| Windows Type 3 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 4 | | | 3.38 | x | 1/[1/( 1.43 )+ 0.04] | = | 4.57 | | | (27) |
| Windows Type 5 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 6 | | | 1.26 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.7 | | | (27) |
| Windows Type 7 | | | 2.52 | x | 1/[1/( 1.43 )+ 0.04] | = | 3.41 | | | (27) |
| Windows Type 8 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 9 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 10 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 11 | | | 1.1 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.49 | | | (27) |
| Windows Type 12 | | | 1.1 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.49 | | | (27) |
| Windows Type 13 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Floor | | | 45.75 | x | 0.12 | = | 5.49 | | | (28) |
| Walls | 78 | 21.02 | 56.98 | x | 0.22 | = | 12.54 | | | (29) |
| Roof | 46.94 | 0 | 46.94 | x | 0.09 | = | 4.22 | | | (30) |

# SAP WorkSheet: New dwelling design stage

Total area of elements, m² 170.69 (31)

** 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) = 49.93 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 7272.51 (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 20.53 (36)

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

Total fabric heat loss (33) + (36) = 70.47 (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= | 48.82 | 48.39 | 47.97 | 45.99 | 45.62 | 43.89 | 43.89 | 43.57 | 44.56 | 45.62 | 46.37 | 47.15 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 119.29 | 118.86 | 118.43 | 116.45 | 116.08 | 114.36 | 114.36 | 114.04 | 115.02 | 116.08 | 116.83 | 117.62 | |

Average = Sum(39)$_{1...12}$ /12= 116.45 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.3 | 1.3 | 1.29 | 1.27 | 1.27 | 1.25 | 1.25 | 1.25 | 1.26 | 1.27 | 1.28 | 1.29 | |

Average = Sum(40)$_{1...12}$ /12= 1.27 (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 2.65 (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 97.04 (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= | 106.74 | 102.86 | 98.98 | 95.09 | 91.21 | 87.33 | 87.33 | 91.21 | 95.09 | 98.98 | 102.86 | 106.74 | |

Total = Sum(44)$_{1...12}$ = 1164.42 (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= | 158.29 | 138.44 | 142.86 | 124.55 | 119.51 | 103.13 | 95.56 | 109.66 | 110.97 | 129.32 | 141.17 | 153.3 | |

Total = Sum(45)$_{1...12}$ = 1526.74 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.74 | 20.77 | 21.43 | 18.68 | 17.93 | 15.47 | 14.33 | 16.45 | 16.65 | 19.4 | 21.17 | 22.99 | (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)

# SAP 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= | 34.2 | 30.88 | 34.18 | 33.07 | 34.16 | 33.04 | 34.14 | 34.15 | 33.06 | 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= | 192.49 | 169.33 | 177.04 | 157.61 | 153.66 | 136.17 | 129.7 | 143.81 | 144.02 | 163.49 | 174.25 | 187.49 | (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= | 192.49 | 169.33 | 177.04 | 157.61 | 153.66 | 136.17 | 129.7 | 143.81 | 144.02 | 163.49 | 174.25 | 187.49 | |

Output from water heater (annual)$_{1...12}$: 1929.07 (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= | 61.18 | 53.75 | 56.05 | 49.68 | 48.28 | 42.55 | 40.31 | 45 | 45.16 | 51.54 | 55.21 | 59.52 | (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= | 158.74 | 158.74 | 158.74 | 158.74 | 158.74 | 158.74 | 158.74 | 158.74 | 158.74 | 158.74 | 158.74 | 158.74 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 53.89 | 47.87 | 38.93 | 29.47 | 22.03 | 18.6 | 20.1 | 26.12 | 35.06 | 44.52 | 51.96 | 55.39 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 360.91 | 364.66 | 355.22 | 335.13 | 309.77 | 285.93 | 270 | 266.26 | 275.7 | 295.79 | 321.15 | 344.99 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 53.52 | 53.52 | 53.52 | 53.52 | 53.52 | 53.52 | 53.52 | 53.52 | 53.52 | 53.52 | 53.52 | 53.52 | (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= | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | (71) |

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Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 82.23 | 79.99 | 75.33 | 69 | 64.89 | 59.1 | 54.18 | 60.48 | 62.72 | 69.28 | 76.68 | 80 |

(72)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 606.47 | 601.95 | 578.91 | 543.03 | 506.12 | 473.06 | 453.71 | 462.3 | 482.92 | 519.02 | 559.22 | 589.81 |

(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) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (75) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 36.79 | x | 0.63 | x | 0.7 | = | 38.01 | (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 | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 62.67 | x | 0.63 | x | 0.7 | = | 64.74 | (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 | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 85.75 | x | 0.63 | x | 0.7 | = | 88.58 | (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 | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 106.25 | x | 0.63 | x | 0.7 | = | 109.75 | (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 | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 119.01 | x | 0.63 | x | 0.7 | = | 122.93 | (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 | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 118.15 | x | 0.63 | x | 0.7 | = | 122.05 | (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 | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 113.91 | x | 0.63 | x | 0.7 | = | 117.67 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 3.38 | x | 104.39 | x | 0.63 | x | 0.7 | = | 107.83 | (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 | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 92.85 | x | 0.63 | x | 0.7 | = | 95.91 | (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 | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 69.27 | x | 0.63 | x | 0.7 | = | 71.55 | (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 | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 44.07 | x | 0.63 | x | 0.7 | = | 45.52 | (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 | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 31.49 | x | 0.63 | x | 0.7 | = | 32.53 | (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 | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (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 | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (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 | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (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 | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (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 | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (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 | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (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 | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (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 | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (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 | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 119.01 | | 0.63 | x | 0.7 | = | 58.92 | (79) |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 119.01 | | 0.63 | x | 0.7 | = | 58.92 | (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 | 1.44 | x | 119.01 | | 0.63 | x | 0.7 | = | 52.37 | (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 | 1.44 | x | 119.01 | | 0.63 | x | 0.7 | = | 52.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 118.15 | | 0.63 | x | 0.7 | = | 58.5 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 118.15 | | 0.63 | x | 0.7 | = | 58.5 | (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 | 1.44 | x | 118.15 | | 0.63 | x | 0.7 | = | 52 | (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 | 1.44 | x | 118.15 | | 0.63 | x | 0.7 | = | 52 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 113.91 | | 0.63 | x | 0.7 | = | 56.4 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 113.91 | | 0.63 | x | 0.7 | = | 56.4 | (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 | 1.44 | x | 113.91 | | 0.63 | x | 0.7 | = | 50.13 | (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 | 1.44 | x | 113.91 | | 0.63 | x | 0.7 | = | 50.13 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 104.39 | | 0.63 | x | 0.7 | = | 51.68 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 104.39 | | 0.63 | x | 0.7 | = | 51.68 | (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 | 1.44 | x | 104.39 | | 0.63 | x | 0.7 | = | 45.94 | (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 | 1.44 | x | 104.39 | | 0.63 | x | 0.7 | = | 45.94 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 92.85 | | 0.63 | x | 0.7 | = | 45.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 92.85 | | 0.63 | x | 0.7 | = | 45.97 | (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 | 1.44 | x | 92.85 | | 0.63 | x | 0.7 | = | 40.86 | (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 | 1.44 | x | 92.85 | | 0.63 | x | 0.7 | = | 40.86 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 69.27 | | 0.63 | x | 0.7 | = | 34.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 69.27 | | 0.63 | x | 0.7 | = | 34.29 | (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 | 1.44 | x | 69.27 | | 0.63 | x | 0.7 | = | 30.48 | (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 | 1.44 | x | 69.27 | | 0.63 | x | 0.7 | = | 30.48 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 44.07 | | 0.63 | x | 0.7 | = | 21.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 44.07 | | 0.63 | x | 0.7 | = | 21.82 | (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 | 1.44 | x | 44.07 | | 0.63 | x | 0.7 | = | 19.39 | (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 | 1.44 | x | 44.07 | | 0.63 | x | 0.7 | = | 19.39 | (79) |

# SAP WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (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 | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (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 | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (79) |
| 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 | 2.52 | x | 11.28 | x | 0.63 | x | 0.7 | = | 8.69 | (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 | 1.26 | x | 22.97 | x | 0.63 | x | 0.7 | = | 8.84 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 22.97 | x | 0.63 | x | 0.7 | = | 17.69 | (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 | 1.26 | x | 41.38 | x | 0.63 | x | 0.7 | = | 15.93 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 41.38 | x | 0.63 | x | 0.7 | = | 31.87 | (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 | 1.26 | x | 67.96 | x | 0.63 | x | 0.7 | = | 26.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 67.96 | x | 0.63 | x | 0.7 | = | 52.34 | (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 | 1.26 | x | 91.35 | x | 0.63 | x | 0.7 | = | 35.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 91.35 | x | 0.63 | x | 0.7 | = | 70.35 | (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 | 1.26 | x | 97.38 | x | 0.63 | x | 0.7 | = | 37.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 97.38 | x | 0.63 | x | 0.7 | = | 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 | 1.26 | x | 91.1 | x | 0.63 | x | 0.7 | = | 35.08 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 91.1 | x | 0.63 | x | 0.7 | = | 70.16 | (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 | 1.26 | x | 72.63 | x | 0.63 | x | 0.7 | = | 27.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 72.63 | x | 0.63 | x | 0.7 | = | 55.93 | (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 | 1.26 | x | 50.42 | x | 0.63 | x | 0.7 | = | 19.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 50.42 | x | 0.63 | x | 0.7 | = | 38.83 | (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 | 1.26 | x | 28.07 | x | 0.63 | x | 0.7 | = | 10.81 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 28.07 | x | 0.63 | x | 0.7 | = | 21.62 | (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 | 1.26 | x | 14.2 | x | 0.63 | x | 0.7 | = | 5.47 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 14.2 | x | 0.63 | x | 0.7 | = | 10.93 | (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 | 1.26 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.55 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 9.21 | x | 0.63 | x | 0.7 | = | 7.1 | (81) |

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| 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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 166.68 | 290.65 | 415.57 | 544.9 | 637.7 | 645.13 | 616.96 | 545.89 | 460.07 | 326.06 | 200.87 | 141.85 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 773.15 | 892.6 | 994.49 | 1087.93 | 1143.82 | 1118.19 | 1070.68 | 1008.19 | 942.99 | 845.08 | 760.09 | 731.66 | (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 | 0.98 | 0.96 | 0.91 | 0.8 | 0.62 | 0.46 | 0.51 | 0.75 | 0.93 | 0.98 | 0.99 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.78 | 19.96 | 20.24 | 20.58 | 20.83 | 20.96 | 20.99 | 20.99 | 20.91 | 20.58 | 20.12 | 19.75 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.84 | 19.84 | 19.85 | 19.86 | 19.87 | 19.88 | 19.88 | 19.88 | 19.87 | 19.87 | 19.86 | 19.85 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.99 | 0.98 | 0.95 | 0.88 | 0.74 | 0.53 | 0.35 | 0.39 | 0.66 | 0.91 | 0.98 | 0.99 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.25 | 18.52 | 18.92 | 19.4 | 19.71 | 19.86 | 19.88 | 19.88 | 19.81 | 19.41 | 18.76 | 18.22 | (90) |

fLA = Living area ÷ (4) = 0.2 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.55 | 18.81 | 19.18 | 19.63 | 19.94 | 20.08 | 20.1 | 20.1 | 20.03 | 19.64 | 19.03 | 18.52 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.4 | 18.66 | 19.03 | 19.48 | 19.79 | 19.93 | 19.95 | 19.95 | 19.88 | 19.49 | 18.88 | 18.37 | (93) |

## 8. Space heating requirement

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

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

Utilisation factor for gains, hm:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (94)m= | 0.98 | 0.97 | 0.94 | 0.87 | 0.73 | 0.53 | 0.36 | 0.4 | 0.66 | 0.89 | 0.97 | 0.99 | (94) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 760.83 | 866.11 | 935.65 | 946.17 | 838.77 | 592.71 | 381.05 | 401.44 | 620.45 | 755.79 | 737.46 | 722.28 | (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= | 1681.92 | 1635.12 | 1483.96 | 1232.16 | 938.59 | 609.14 | 383.01 | 404.74 | 664.63 | 1032.23 | 1376.41 | 1666.64 | (97) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 685.29 | 516.78 | 407.94 | 205.91 | 74.26 | 0 | 0 | 0 | 0 | 205.68 | 460.04 | 702.61 | |

Total per year (kWh/year) = Sum(98)$_{1…5,9…12}$ = 3258.5 (98)

Space heating requirement in kWh/m²/year 35.61 (99)

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

**Space heating:**

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

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| | | |
|---|---|---|
| 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) | 685.29 | 516.78 | 407.94 | 205.91 | 74.26 | 0 | 0 | 0 | 0 | 205.68 | 460.04 | 702.61 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) (211) | 759.74 | 572.92 | 452.27 | 228.28 | 82.33 | 0 | 0 | 0 | 0 | 228.02 | 510.02 | 778.94 | |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3612.53 (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 | |

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 192.49 | 169.33 | 177.04 | 157.61 | 153.66 | 136.17 | 129.7 | 143.81 | 144.02 | 163.49 | 174.25 | 187.49 | |

Efficiency of water heater 87 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 89.48 | 89.39 | 89.21 | 88.78 | 88.02 | 87 | 87 | 87 | 87 | 88.75 | 89.3 | 89.51 | (217) |

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 215.12 | 189.43 | 198.46 | 177.53 | 174.58 | 156.52 | 149.08 | 165.3 | 165.54 | 184.21 | 195.13 | 209.47 | |

Total = Sum(219a)$_{1...12}$ = 2180.37 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 3612.53 |
| Water heating fuel used | | 2180.37 |
| 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 | | 380.71 (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 = | 125.72 (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 = | 75.88 (247) |
| Pumps, fans and electric keep-hot | (231) | 13.19 x 0.01 = | 9.89 (249) |

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| | | | | | |
|---|---|---|---|---|---|
| (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 = | 50.22 | (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) = | | | 275.76 | (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] = | 0.85 | (257) |
| **SAP rating (Section 12)** | | 88.16 | (258) |

## 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 | = | 780.31 | (261) |
| Space heating (secondary) | (215) x | | 0.519 | = | 0 | (263) |
| Water heating | (219) x | | 0.216 | = | 470.96 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 1251.27 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | | 0.519 | = | 197.59 | (268) |
| Energy saving/generation technologies Item 1 | | | 0.519 | = | -416.86 | (269) |
| Total CO2, kg/year | sum of (265)…(271) = | | | | 1070.92 | (272) |
| **CO2 emissions per m²** | (272) ÷ (4) = | | | | 11.7 | (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 | = | 4407.29 | (261) |
| Space heating (secondary) | (215) x | | 3.07 | = | 0 | (263) |
| Energy for water heating | (219) x | | 1.22 | = | 2660.05 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 7067.34 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | | 3.07 | = | 230.25 | (267) |
| Electricity for lighting | (232) x | | 0 | = | 1168.79 | (268) |
| Energy saving/generation technologies Item 1 | | | 3.07 | = | -2465.81 | (269) |
| 'Total Primary Energy | sum of (265)…(271) = | | | | 6000.56 | (272) |
| **Primary energy kWh/m²/year** | (272) ÷ (4) = | | | | 65.58 | (273) |

# SAP WorkSheet: New dwelling design stage

# 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 57

**Address :** Plot 57 , Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 45.75 (1a) | x | 2.38 (2a) | = | 108.89 | (3a) |
| Ground floor | 45.75 (1b) | x | 2.62 (2b) | = | 119.86 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 91.5 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 228.75 | (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) = | 0.13 | (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) | | | 0.38 | (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) = | | 0.38 | (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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.49 | 0.48 | 0.47 | 0.42 | 0.41 | 0.36 | 0.36 | 0.35 | 0.38 | 0.41 | 0.43 | 0.45 |

*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 | 0.61 | 0.61 | 0.59 | 0.58 | 0.57 | 0.57 | 0.56 | 0.57 | 0.58 | 0.59 | 0.6 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.62 | 0.61 | 0.61 | 0.59 | 0.58 | 0.57 | 0.57 | 0.56 | 0.57 | 0.58 | 0.59 | 0.6 |

(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 | | | 1.62 | x1/[1/( 1.4 )+ 0.04] | | = | 2.15 | | | (27) |
| Windows Type 2 | | | 1.62 | x1/[1/( 1.4 )+ 0.04] | | = | 2.15 | | | (27) |
| Windows Type 3 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 4 | | | 3.38 | x1/[1/( 1.4 )+ 0.04] | | = | 4.48 | | | (27) |
| Windows Type 5 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 6 | | | 1.26 | x1/[1/( 1.4 )+ 0.04] | | = | 1.67 | | | (27) |
| Windows Type 7 | | | 2.52 | x1/[1/( 1.4 )+ 0.04] | | = | 3.34 | | | (27) |
| Windows Type 8 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 9 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 10 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 11 | | | 1.1 | x1/[1/( 1.4 )+ 0.04] | | = | 1.46 | | | (27) |
| Windows Type 12 | | | 1.1 | x1/[1/( 1.4 )+ 0.04] | | = | 1.46 | | | (27) |
| Windows Type 13 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Floor | | | 45.75 | x | 0.13 | = | 5.9475 | | | (28) |
| Walls | 78 | 21.02 | 56.98 | x | 0.18 | = | 10.26 | | | (29) |
| Roof | 46.94 | 0 | 46.94 | x | 0.13 | = | 6.1 | | | (30) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

Total area of elements, m² | 170.69 | (31)

** 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) = | 49.91 | (33)

Heat capacity Cm = S(A x k ) | ((28)…(30) + (32) + (32a)…(32e) = | 7272.51 | (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 | 10.93 | (36)

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

Total fabric heat loss | (33) + (36) = | 60.83 | (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= | 46.66 | 46.31 | 45.97 | 44.38 | 44.08 | 42.69 | 42.69 | 42.44 | 43.23 | 44.08 | 44.68 | 45.31 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 107.49 | 107.14 | 106.8 | 105.21 | 104.91 | 103.52 | 103.52 | 103.27 | 104.06 | 104.91 | 105.52 | 106.15 | |

Average = Sum(39)$_{1...12}$ /12= | 105.21 | (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.17 | 1.17 | 1.17 | 1.15 | 1.15 | 1.13 | 1.13 | 1.13 | 1.14 | 1.15 | 1.15 | 1.16 | |

Average = Sum(40)$_{1...12}$ /12= | 1.15 | (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 | 2.65 | (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 | 97.04 | (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= | 106.74 | 102.86 | 98.98 | 95.09 | 91.21 | 87.33 | 87.33 | 91.21 | 95.09 | 98.98 | 102.86 | 106.74 | |

Total = Sum(44)$_{1...12}$ = | 1164.42 | (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= | 158.29 | 138.44 | 142.86 | 124.55 | 119.51 | 103.13 | 95.56 | 109.66 | 110.97 | 129.32 | 141.17 | 153.3 | |

Total = Sum(45)$_{1...12}$ = | 1526.74 | (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= | 134.55 | 117.68 | 121.43 | 105.87 | 101.58 | 87.66 | 81.23 | 93.21 | 94.32 | 109.92 | 119.99 | 130.3 | (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= | 134.55 | 117.68 | 121.43 | 105.87 | 101.58 | 87.66 | 81.23 | 93.21 | 94.32 | 109.92 | 119.99 | 130.3 | |

Output from water heater (annual)$_{1...12}$: 1297.73 (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= | 33.64 | 29.42 | 30.36 | 26.47 | 25.4 | 21.91 | 20.31 | 23.3 | 23.58 | 27.48 | 30 | 32.58 | (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= | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 21.56 | 19.15 | 15.57 | 11.79 | 8.81 | 7.44 | 8.04 | 10.45 | 14.02 | 17.81 | 20.78 | 22.16 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 241.81 | 244.32 | 238 | 224.54 | 207.54 | 191.57 | 180.9 | 178.39 | 184.72 | 198.18 | 215.17 | 231.14 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | (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= | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | (71) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 45.21 | 43.78 | 40.8 | 36.76 | 34.13 | 30.44 | 27.29 | 31.32 | 32.75 | 36.94 | 41.66 | 43.78 | (72) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 371.26 | 369.93 | 357.06 | 335.77 | 313.17 | 292.13 | 278.92 | 282.85 | 294.18 | 315.61 | 340.3 | 359.77 | (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) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (75) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 36.79 | x | 0.63 | x | 0.7 | = | 38.01 | (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 | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 62.67 | x | 0.63 | x | 0.7 | = | 64.74 | (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 | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 85.75 | x | 0.63 | x | 0.7 | = | 88.58 | (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 | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 106.25 | x | 0.63 | x | 0.7 | = | 109.75 | (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 | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 119.01 | x | 0.63 | x | 0.7 | = | 122.93 | (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 | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 118.15 | x | 0.63 | x | 0.7 | = | 122.05 | (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 | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 113.91 | x | 0.63 | x | 0.7 | = | 117.67 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 3.38 | x | 104.39 | x | 0.63 | x | 0.7 | = | 107.83 | (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 | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 92.85 | x | 0.63 | x | 0.7 | = | 95.91 | (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 | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 69.27 | x | 0.63 | x | 0.7 | = | 71.55 | (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 | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 44.07 | x | 0.63 | x | 0.7 | = | 45.52 | (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 | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 31.49 | x | 0.63 | x | 0.7 | = | 32.53 | (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 | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (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 | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (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 | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (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 | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (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 | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (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 | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (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 | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (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 | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (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 | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 119.01 | | 0.63 | x | 0.7 | = | 58.92 | (79) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 119.01 | | 0.63 | x | 0.7 | = | 58.92 | (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 | 1.44 | x | 119.01 | | 0.63 | x | 0.7 | = | 52.37 | (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 | 1.44 | x | 119.01 | | 0.63 | x | 0.7 | = | 52.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 118.15 | | 0.63 | x | 0.7 | = | 58.5 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 118.15 | | 0.63 | x | 0.7 | = | 58.5 | (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 | 1.44 | x | 118.15 | | 0.63 | x | 0.7 | = | 52 | (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 | 1.44 | x | 118.15 | | 0.63 | x | 0.7 | = | 52 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 113.91 | | 0.63 | x | 0.7 | = | 56.4 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 113.91 | | 0.63 | x | 0.7 | = | 56.4 | (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 | 1.44 | x | 113.91 | | 0.63 | x | 0.7 | = | 50.13 | (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 | 1.44 | x | 113.91 | | 0.63 | x | 0.7 | = | 50.13 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 104.39 | | 0.63 | x | 0.7 | = | 51.68 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 104.39 | | 0.63 | x | 0.7 | = | 51.68 | (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 | 1.44 | x | 104.39 | | 0.63 | x | 0.7 | = | 45.94 | (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 | 1.44 | x | 104.39 | | 0.63 | x | 0.7 | = | 45.94 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 92.85 | | 0.63 | x | 0.7 | = | 45.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 92.85 | | 0.63 | x | 0.7 | = | 45.97 | (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 | 1.44 | x | 92.85 | | 0.63 | x | 0.7 | = | 40.86 | (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 | 1.44 | x | 92.85 | | 0.63 | x | 0.7 | = | 40.86 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 69.27 | | 0.63 | x | 0.7 | = | 34.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 69.27 | | 0.63 | x | 0.7 | = | 34.29 | (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 | 1.44 | x | 69.27 | | 0.63 | x | 0.7 | = | 30.48 | (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 | 1.44 | x | 69.27 | | 0.63 | x | 0.7 | = | 30.48 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 44.07 | | 0.63 | x | 0.7 | = | 21.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 44.07 | | 0.63 | x | 0.7 | = | 21.82 | (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 | 1.44 | x | 44.07 | | 0.63 | x | 0.7 | = | 19.39 | (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 | 1.44 | x | 44.07 | | 0.63 | x | 0.7 | = | 19.39 | (79) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (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 | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (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 | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (79) |
| 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 | 2.52 | x | 11.28 | x | 0.63 | x | 0.7 | = | 8.69 | (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 | 1.26 | x | 22.97 | x | 0.63 | x | 0.7 | = | 8.84 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 22.97 | x | 0.63 | x | 0.7 | = | 17.69 | (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 | 1.26 | x | 41.38 | x | 0.63 | x | 0.7 | = | 15.93 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 41.38 | x | 0.63 | x | 0.7 | = | 31.87 | (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 | 1.26 | x | 67.96 | x | 0.63 | x | 0.7 | = | 26.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 67.96 | x | 0.63 | x | 0.7 | = | 52.34 | (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 | 1.26 | x | 91.35 | x | 0.63 | x | 0.7 | = | 35.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 91.35 | x | 0.63 | x | 0.7 | = | 70.35 | (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 | 1.26 | x | 97.38 | x | 0.63 | x | 0.7 | = | 37.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 97.38 | x | 0.63 | x | 0.7 | = | 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 | 1.26 | x | 91.1 | x | 0.63 | x | 0.7 | = | 35.08 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 91.1 | x | 0.63 | x | 0.7 | = | 70.16 | (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 | 1.26 | x | 72.63 | x | 0.63 | x | 0.7 | = | 27.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 72.63 | x | 0.63 | x | 0.7 | = | 55.93 | (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 | 1.26 | x | 50.42 | x | 0.63 | x | 0.7 | = | 19.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 50.42 | x | 0.63 | x | 0.7 | = | 38.83 | (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 | 1.26 | x | 28.07 | x | 0.63 | x | 0.7 | = | 10.81 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 28.07 | x | 0.63 | x | 0.7 | = | 21.62 | (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 | 1.26 | x | 14.2 | x | 0.63 | x | 0.7 | = | 5.47 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 14.2 | x | 0.63 | x | 0.7 | = | 10.93 | (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 | 1.26 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.55 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 9.21 | x | 0.63 | x | 0.7 | = | 7.1 | (81) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

| Northwest 0.9x | | x | | x | | x | | x | | = | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.77 | | 1.44 | | 9.21 | | 0.63 | | 0.7 | | 4.06 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 166.68 | 290.65 | 415.57 | 544.9 | 637.7 | 645.13 | 616.96 | 545.89 | 460.07 | 326.06 | 200.87 | 141.85 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 537.95 | 660.58 | 772.63 | 880.67 | 950.88 | 937.26 | 895.88 | 828.74 | 754.25 | 641.67 | 541.18 | 501.62 | (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 | 0.98 | 0.95 | 0.84 | 0.67 | 0.5 | 0.56 | 0.81 | 0.97 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.71 | 19.91 | 20.19 | 20.55 | 20.82 | 20.96 | 20.99 | 20.99 | 20.89 | 20.52 | 20.05 | 19.69 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.94 | 19.94 | 19.95 | 19.96 | 19.96 | 19.98 | 19.98 | 19.98 | 19.97 | 19.96 | 19.96 | 19.95 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.93 | 0.79 | 0.58 | 0.39 | 0.44 | 0.74 | 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= | 18.77 | 18.97 | 19.25 | 19.6 | 19.85 | 19.96 | 19.97 | 19.97 | 19.91 | 19.58 | 19.12 | 18.75 | (90) |

fLA = Living area ÷ (4) = 0.2 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.96 | 19.15 | 19.44 | 19.79 | 20.04 | 20.16 | 20.18 | 20.18 | 20.11 | 19.77 | 19.3 | 18.94 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.96 | 19.15 | 19.44 | 19.79 | 20.04 | 20.16 | 20.18 | 20.18 | 20.11 | 19.77 | 19.3 | 18.94 | (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 | 0.92 | 0.8 | 0.59 | 0.41 | 0.47 | 0.75 | 0.95 | 0.99 | 1 | (94) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 536.19 | 654.64 | 753.03 | 812.42 | 758.72 | 555.82 | 367.77 | 385.43 | 564.46 | 611.25 | 537.09 | 500.45 | (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= | 1575.61 | 1527.12 | 1381.78 | 1145.85 | 875.12 | 575.33 | 370.19 | 389.88 | 625.22 | 962.03 | 1287.57 | 1564.35 | (97) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 773.33 | 586.3 | 467.79 | 240.07 | 86.6 | 0 | 0 | 0 | 0 | 260.98 | 540.34 | 791.54 | |

Total per year (kWh/year) = Sum(98)$_{1…5,9…12}$ = 3746.96 (98)

Space heating requirement in kWh/m²/year 40.95 (99)

## 8c. Space cooling requirement

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

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | 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 | 973.13 | 766.08 | 784.83 | 0 | 0 | 0 | 0 | (100) |
| Utilisation factor for loss hm | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.91 | 0.95 | 0.94 | 0 | 0 | 0 | 0 | (101) |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 884.29 | 730.22 | 733.87 | 0 | 0 | 0 | 0 | (102) |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 1195.44 | 1144.95 | 1068.19 | 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 | 224.03 | 308.57 | 248.73 | 0 | 0 | 0 | 0 | |

Total = Sum(104) = 781.33 (104)

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

Intermittency factor (Table 10b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (106)m= | 0 | 0 | 0 | 0 | 0 | 0.25 | 0.25 | 0.25 | 0 | 0 | 0 | 0 | |

*Total = Sum(104)* = 0 (106)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (107)m= | 0 | 0 | 0 | 0 | 0 | 56.01 | 77.14 | 62.18 | 0 | 0 | 0 | 0 | |

Total = Sum(107) = 195.33 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 2.13 (108)

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

Fabric Energy Efficiency — (99) + (108) = 43.09 (109)

**Target Fabric Energy Efficiency (TFEE)** 49.55 (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 57

**Address :** Plot 57 , Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 45.75 (1a) | x | 2.38 (2a) | = | 108.89 | (3a) |
| Ground floor | 45.75 (1b) | x | 2.62 (2b) | = | 119.86 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 91.5 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 228.75 | (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) = | 0.13 (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) | | 0.38 (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) = | | 0.38 (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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.49 | 0.48 | 0.47 | 0.42 | 0.41 | 0.36 | 0.36 | 0.35 | 0.38 | 0.41 | 0.43 | 0.45 |

*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 | 0.61 | 0.61 | 0.59 | 0.58 | 0.57 | 0.57 | 0.56 | 0.57 | 0.58 | 0.59 | 0.6 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.62 | 0.61 | 0.61 | 0.59 | 0.58 | 0.57 | 0.57 | 0.56 | 0.57 | 0.58 | 0.59 | 0.6 |

(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 | | | 1.62 | x | 1/[1/( 1.43 )+ 0.04] | = | 2.19 | | | (27) |
| Windows Type 2 | | | 1.62 | x | 1/[1/( 1.43 )+ 0.04] | = | 2.19 | | | (27) |
| Windows Type 3 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 4 | | | 3.38 | x | 1/[1/( 1.43 )+ 0.04] | = | 4.57 | | | (27) |
| Windows Type 5 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 6 | | | 1.26 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.7 | | | (27) |
| Windows Type 7 | | | 2.52 | x | 1/[1/( 1.43 )+ 0.04] | = | 3.41 | | | (27) |
| Windows Type 8 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 9 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 10 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 11 | | | 1.1 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.49 | | | (27) |
| Windows Type 12 | | | 1.1 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.49 | | | (27) |
| Windows Type 13 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Floor | | | 45.75 | x | 0.12 | = | 5.49 | | | (28) |
| Walls | 78 | 21.02 | 56.98 | x | 0.22 | = | 12.54 | | | (29) |
| Roof | 46.94 | 0 | 46.94 | x | 0.09 | = | 4.22 | | | (30) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

Total area of elements, m² | 170.69 | (31)

** 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) = | 49.93 | (33)

Heat capacity Cm = S(A x k ) | ((28)…(30) + (32) + (32a)…(32e) = | 7272.51 | (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 | 20.53 | (36)

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

Total fabric heat loss | (33) + (36) = | 70.47 | (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= | 46.66 | 46.31 | 45.97 | 44.38 | 44.08 | 42.69 | 42.69 | 42.44 | 43.23 | 44.08 | 44.68 | 45.31 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 117.12 | 116.78 | 116.44 | 114.85 | 114.55 | 113.16 | 113.16 | 112.9 | 113.69 | 114.55 | 115.15 | 115.78 | |

Average = Sum(39)$_{1...12}$ /12= | 114.84 | (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.28 | 1.28 | 1.27 | 1.26 | 1.25 | 1.24 | 1.24 | 1.23 | 1.24 | 1.25 | 1.26 | 1.27 | |

Average = Sum(40)$_{1...12}$ /12= | 1.26 | (40)

Number of days in month (Table 1a)

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

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

Assumed occupancy, N | 2.65 | (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 | 97.04 | (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= | 106.74 | 102.86 | 98.98 | 95.09 | 91.21 | 87.33 | 87.33 | 91.21 | 95.09 | 98.98 | 102.86 | 106.74 | |

Total = Sum(44)$_{1...12}$ = | 1164.42 | (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= | 158.29 | 138.44 | 142.86 | 124.55 | 119.51 | 103.13 | 95.56 | 109.66 | 110.97 | 129.32 | 141.17 | 153.3 | |

Total = Sum(45)$_{1...12}$ = | 1526.74 | (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)

# Dwelling 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= | 134.55 | 117.68 | 121.43 | 105.87 | 101.58 | 87.66 | 81.23 | 93.21 | 94.32 | 109.92 | 119.99 | 130.3 | (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= | 134.55 | 117.68 | 121.43 | 105.87 | 101.58 | 87.66 | 81.23 | 93.21 | 94.32 | 109.92 | 119.99 | 130.3 | |

Output from water heater (annual)$_{1...12}$: 1297.73 (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= | 33.64 | 29.42 | 30.36 | 26.47 | 25.4 | 21.91 | 20.31 | 23.3 | 23.58 | 27.48 | 30 | 32.58 | (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= | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 21.56 | 19.15 | 15.57 | 11.79 | 8.81 | 7.44 | 8.04 | 10.45 | 14.02 | 17.81 | 20.78 | 22.16 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 241.81 | 244.32 | 238 | 224.54 | 207.54 | 191.57 | 180.9 | 178.39 | 184.72 | 198.18 | 215.17 | 231.14 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | (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= | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | (71) |

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Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 45.21 | 43.78 | 40.8 | 36.76 | 34.13 | 30.44 | 27.29 | 31.32 | 32.75 | 36.94 | 41.66 | 43.78 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 371.26 | 369.93 | 357.06 | 335.77 | 313.17 | 292.13 | 278.92 | 282.85 | 294.18 | 315.61 | 340.3 | 359.77 | (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) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (75) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 36.79 | x | 0.63 | x | 0.7 | = | 38.01 | (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 | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 62.67 | x | 0.63 | x | 0.7 | = | 64.74 | (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 | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 85.75 | x | 0.63 | x | 0.7 | = | 88.58 | (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 | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 106.25 | x | 0.63 | x | 0.7 | = | 109.75 | (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 | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 119.01 | x | 0.63 | x | 0.7 | = | 122.93 | (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 | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 118.15 | x | 0.63 | x | 0.7 | = | 122.05 | (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 | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 113.91 | x | 0.63 | x | 0.7 | = | 117.67 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 3.38 | x | 104.39 | x | 0.63 | x | 0.7 | = | 107.83 | (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 | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 92.85 | x | 0.63 | x | 0.7 | = | 95.91 | (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 | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 69.27 | x | 0.63 | x | 0.7 | = | 71.55 | (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 | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 44.07 | x | 0.63 | x | 0.7 | = | 45.52 | (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 | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 31.49 | x | 0.63 | x | 0.7 | = | 32.53 | (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 | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (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 | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (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 | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (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 | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (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 | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (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 | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (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 | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (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 | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (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 | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 119.01 | | 0.63 | x | 0.7 | = | 58.92 | (79) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 119.01 | | 0.63 | x | 0.7 | = | 58.92 | (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 | 1.44 | x | 119.01 | | 0.63 | x | 0.7 | = | 52.37 | (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 | 1.44 | x | 119.01 | | 0.63 | x | 0.7 | = | 52.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 118.15 | | 0.63 | x | 0.7 | = | 58.5 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 118.15 | | 0.63 | x | 0.7 | = | 58.5 | (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 | 1.44 | x | 118.15 | | 0.63 | x | 0.7 | = | 52 | (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 | 1.44 | x | 118.15 | | 0.63 | x | 0.7 | = | 52 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 113.91 | | 0.63 | x | 0.7 | = | 56.4 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 113.91 | | 0.63 | x | 0.7 | = | 56.4 | (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 | 1.44 | x | 113.91 | | 0.63 | x | 0.7 | = | 50.13 | (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 | 1.44 | x | 113.91 | | 0.63 | x | 0.7 | = | 50.13 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 104.39 | | 0.63 | x | 0.7 | = | 51.68 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 104.39 | | 0.63 | x | 0.7 | = | 51.68 | (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 | 1.44 | x | 104.39 | | 0.63 | x | 0.7 | = | 45.94 | (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 | 1.44 | x | 104.39 | | 0.63 | x | 0.7 | = | 45.94 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 92.85 | | 0.63 | x | 0.7 | = | 45.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 92.85 | | 0.63 | x | 0.7 | = | 45.97 | (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 | 1.44 | x | 92.85 | | 0.63 | x | 0.7 | = | 40.86 | (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 | 1.44 | x | 92.85 | | 0.63 | x | 0.7 | = | 40.86 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 69.27 | | 0.63 | x | 0.7 | = | 34.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 69.27 | | 0.63 | x | 0.7 | = | 34.29 | (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 | 1.44 | x | 69.27 | | 0.63 | x | 0.7 | = | 30.48 | (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 | 1.44 | x | 69.27 | | 0.63 | x | 0.7 | = | 30.48 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 44.07 | | 0.63 | x | 0.7 | = | 21.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 44.07 | | 0.63 | x | 0.7 | = | 21.82 | (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 | 1.44 | x | 44.07 | | 0.63 | x | 0.7 | = | 19.39 | (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 | 1.44 | x | 44.07 | | 0.63 | x | 0.7 | = | 19.39 | (79) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (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 | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (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 | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (79) |
| 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 | 2.52 | x | 11.28 | x | 0.63 | x | 0.7 | = | 8.69 | (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 | 1.26 | x | 22.97 | x | 0.63 | x | 0.7 | = | 8.84 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 22.97 | x | 0.63 | x | 0.7 | = | 17.69 | (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 | 1.26 | x | 41.38 | x | 0.63 | x | 0.7 | = | 15.93 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 41.38 | x | 0.63 | x | 0.7 | = | 31.87 | (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 | 1.26 | x | 67.96 | x | 0.63 | x | 0.7 | = | 26.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 67.96 | x | 0.63 | x | 0.7 | = | 52.34 | (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 | 1.26 | x | 91.35 | x | 0.63 | x | 0.7 | = | 35.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 91.35 | x | 0.63 | x | 0.7 | = | 70.35 | (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 | 1.26 | x | 97.38 | x | 0.63 | x | 0.7 | = | 37.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 97.38 | x | 0.63 | x | 0.7 | = | 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 | 1.26 | x | 91.1 | x | 0.63 | x | 0.7 | = | 35.08 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 91.1 | x | 0.63 | x | 0.7 | = | 70.16 | (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 | 1.26 | x | 72.63 | x | 0.63 | x | 0.7 | = | 27.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 72.63 | x | 0.63 | x | 0.7 | = | 55.93 | (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 | 1.26 | x | 50.42 | x | 0.63 | x | 0.7 | = | 19.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 50.42 | x | 0.63 | x | 0.7 | = | 38.83 | (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 | 1.26 | x | 28.07 | x | 0.63 | x | 0.7 | = | 10.81 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 28.07 | x | 0.63 | x | 0.7 | = | 21.62 | (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 | 1.26 | x | 14.2 | x | 0.63 | x | 0.7 | = | 5.47 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 14.2 | x | 0.63 | x | 0.7 | = | 10.93 | (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 | 1.26 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.55 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 9.21 | x | 0.63 | x | 0.7 | = | 7.1 | (81) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

| Northwest 0.9x | | x | | x | | x | | x | | = | | (81) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.77 | | 1.44 | | 9.21 | | 0.63 | | 0.7 | | 4.06 | |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 166.68 | 290.65 | 415.57 | 544.9 | 637.7 | 645.13 | 616.96 | 545.89 | 460.07 | 326.06 | 200.87 | 141.85 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 537.95 | 660.58 | 772.63 | 880.67 | 950.88 | 937.26 | 895.88 | 828.74 | 754.25 | 641.67 | 541.18 | 501.62 | (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 | 0.87 | 0.71 | 0.54 | 0.6 | 0.84 | 0.97 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.58 | 19.77 | 20.07 | 20.45 | 20.76 | 20.94 | 20.99 | 20.98 | 20.85 | 20.43 | 19.93 | 19.55 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.86 | 19.86 | 19.86 | 19.88 | 19.88 | 19.89 | 19.89 | 19.89 | 19.89 | 19.88 | 19.87 | 19.87 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.94 | 0.82 | 0.61 | 0.41 | 0.47 | 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= | 18.57 | 18.76 | 19.06 | 19.44 | 19.72 | 19.86 | 19.89 | 19.89 | 19.8 | 19.43 | 18.93 | 18.55 | (90) |

fLA = Living area ÷ (4) = 0.2 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.77 | 18.97 | 19.26 | 19.64 | 19.93 | 20.08 | 20.11 | 20.1 | 20.01 | 19.63 | 19.13 | 18.75 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.77 | 18.97 | 19.26 | 19.64 | 19.93 | 20.08 | 20.11 | 20.1 | 20.01 | 19.63 | 19.13 | 18.75 | (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 | 0.93 | 0.82 | 0.63 | 0.44 | 0.49 | 0.77 | 0.96 | 0.99 | 1 | (94) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 536.1 | 654.72 | 754.31 | 819.75 | 780.38 | 587.14 | 392 | 409.94 | 584.28 | 613.97 | 537.1 | 500.37 | (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= | 1694.58 | 1642.5 | 1485.87 | 1233.09 | 942.18 | 619.65 | 396.68 | 418.12 | 672.12 | 1034.1 | 1385.56 | 1684.21 | (97) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 861.9 | 663.79 | 544.28 | 297.6 | 120.38 | 0 | 0 | 0 | 0 | 312.57 | 610.89 | 880.78 | |

Total per year (kWh/year) = Sum(98)$_{1\ldots5,9\ldots12}$ = 4292.2 (98)

Space heating requirement in kWh/m²/year 46.91 (99)

## 8c. Space cooling requirement

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

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | 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 | 1063.69 | 837.38 | 858.06 | 0 | 0 | 0 | 0 | (100) |
| Utilisation factor for loss hm | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.87 | 0.93 | 0.9 | 0 | 0 | 0 | 0 | (101) |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 925.81 | 776.23 | 774.85 | 0 | 0 | 0 | 0 | (102) |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 1195.44 | 1144.95 | 1068.19 | 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 | 194.13 | 274.33 | 218.25 | 0 | 0 | 0 | 0 | |

| | | |
|---|---|---|
| Total = Sum(104) = | 686.71 | (104) |
| Cooled fraction f C = cooled area ÷ (4) = | 1 | (105) |
| Intermittency factor (Table 10b) | | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (106)m= | 0 | 0 | 0 | 0 | 0 | 0.25 | 0.25 | 0.25 | 0 | 0 | 0 | 0 | |

| | | |
|---|---|---|
| *Total = Sum(104)* = | 0 | (106) |
| Space cooling requirement for month = (104)m × (105) × (106)m | | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (107)m= | 0 | 0 | 0 | 0 | 0 | 48.53 | 68.58 | 54.56 | 0 | 0 | 0 | 0 | |

| | | |
|---|---|---|
| Total = Sum(107) = | 171.68 | (107) |
| Space cooling requirement in kWh/m²/year (107) ÷ (4) = | 1.88 | (108) |

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

| | | |
|---|---|---|
| Fabric Energy Efficiency (99) + (108) = | 48.79 | (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 57

**Address :** Plot 57 , Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 45.75 (1a) | x | 2.38 (2a) | = | 108.89 | (3a) |
| Ground floor | 45.75 (1b) | x | 2.62 (2b) | = | 119.86 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 91.5 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 228.75 | (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) = | 0.17 | (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) | | | 0.42 | (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) = | 0.42 | (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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.54 | 0.53 | 0.52 | 0.47 | 0.46 | 0.4 | 0.4 | 0.39 | 0.42 | 0.46 | 0.48 | 0.5 |

*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= | 0.65 | 0.64 | 0.64 | 0.61 | 0.6 | 0.58 | 0.58 | 0.58 | 0.59 | 0.6 | 0.61 | 0.62 |

(24d)

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

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

(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 | | | 1.62 | x | 1/[1/( 1.43 )+ 0.04] | = | 2.19 | | | (27) |
| Windows Type 2 | | | 1.62 | x | 1/[1/( 1.43 )+ 0.04] | = | 2.19 | | | (27) |
| Windows Type 3 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 4 | | | 3.38 | x | 1/[1/( 1.43 )+ 0.04] | = | 4.57 | | | (27) |
| Windows Type 5 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 6 | | | 1.26 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.7 | | | (27) |
| Windows Type 7 | | | 2.52 | x | 1/[1/( 1.43 )+ 0.04] | = | 3.41 | | | (27) |
| Windows Type 8 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 9 | | | 0.66 | x | 1/[1/( 1.43 )+ 0.04] | = | 0.89 | | | (27) |
| Windows Type 10 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 11 | | | 1.1 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.49 | | | (27) |
| Windows Type 12 | | | 1.1 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.49 | | | (27) |
| Windows Type 13 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Floor | | | 45.75 | x | 0.12 | = | 5.49 | | | (28) |
| Walls | 78 | 21.02 | 56.98 | x | 0.22 | = | 12.54 | | | (29) |
| Roof | 46.94 | 0 | 46.94 | x | 0.09 | = | 4.22 | | | (30) |

# DER WorkSheet: New dwelling design stage

Total area of elements, m² | 170.69 | (31)

** 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) = | 49.93 | (33)

Heat capacity Cm = S(A x k ) | ((28)…(30) + (32) + (32a)…(32e) = | 7272.51 | (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 | 20.53 | (36)

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

Total fabric heat loss | (33) + (36) = | 70.47 | (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= | 48.82 | 48.39 | 47.97 | 45.99 | 45.62 | 43.89 | 43.89 | 43.57 | 44.56 | 45.62 | 46.37 | 47.15 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 119.29 | 118.86 | 118.43 | 116.45 | 116.08 | 114.36 | 114.36 | 114.04 | 115.02 | 116.08 | 116.83 | 117.62 | |

Average = Sum(39)$_{1...12}$ /12= | 116.45 | (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.3 | 1.3 | 1.29 | 1.27 | 1.27 | 1.25 | 1.25 | 1.25 | 1.26 | 1.27 | 1.28 | 1.29 | |

Average = Sum(40)$_{1...12}$ /12= | 1.27 | (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 | 2.65 | (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 | 97.04 | (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= | 106.74 | 102.86 | 98.98 | 95.09 | 91.21 | 87.33 | 87.33 | 91.21 | 95.09 | 98.98 | 102.86 | 106.74 | |

Total = Sum(44)$_{1...12}$ = | 1164.42 | (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= | 158.29 | 138.44 | 142.86 | 124.55 | 119.51 | 103.13 | 95.56 | 109.66 | 110.97 | 129.32 | 141.17 | 153.3 | |

Total = Sum(45)$_{1...12}$ = | 1526.74 | (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.74 | 20.77 | 21.43 | 18.68 | 17.93 | 15.47 | 14.33 | 16.45 | 16.65 | 19.4 | 21.17 | 22.99 | (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= | 34.2 | 30.88 | 34.18 | 33.07 | 34.16 | 33.04 | 34.14 | 34.15 | 33.06 | 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= | 192.49 | 169.33 | 177.04 | 157.61 | 153.66 | 136.17 | 129.7 | 143.81 | 144.02 | 163.49 | 174.25 | 187.49 | (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= | 192.49 | 169.33 | 177.04 | 157.61 | 153.66 | 136.17 | 129.7 | 143.81 | 144.02 | 163.49 | 174.25 | 187.49 | |

Output from water heater (annual)$_{1...12}$: 1929.07 (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= | 61.18 | 53.75 | 56.05 | 49.68 | 48.28 | 42.55 | 40.31 | 45 | 45.16 | 51.54 | 55.21 | 59.52 | (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= | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 21.56 | 19.15 | 15.57 | 11.79 | 8.81 | 7.44 | 8.04 | 10.45 | 14.02 | 17.81 | 20.78 | 22.16 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 241.81 | 244.32 | 238 | 224.54 | 207.54 | 191.57 | 180.9 | 178.39 | 184.72 | 198.18 | 215.17 | 231.14 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | (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= | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | (71) |

# DER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 82.23 | 79.99 | 75.33 | 69 | 64.89 | 59.1 | 54.18 | 60.48 | 62.72 | 69.28 | 76.68 | 80 | (72) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 411.29 | 409.14 | 394.59 | 371.01 | 346.93 | 323.79 | 308.8 | 315.01 | 327.15 | 350.95 | 378.32 | 398.98 | (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) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (75) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 36.79 | x | 0.63 | x | 0.7 | = | 38.01 | (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 | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 62.67 | x | 0.63 | x | 0.7 | = | 64.74 | (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 | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 85.75 | x | 0.63 | x | 0.7 | = | 88.58 | (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 | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 106.25 | x | 0.63 | x | 0.7 | = | 109.75 | (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 | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 119.01 | x | 0.63 | x | 0.7 | = | 122.93 | (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 | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 118.15 | x | 0.63 | x | 0.7 | = | 122.05 | (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 | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 113.91 | x | 0.63 | x | 0.7 | = | 117.67 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 3.38 | x | 104.39 | x | 0.63 | x | 0.7 | = | 107.83 | (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 | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 92.85 | x | 0.63 | x | 0.7 | = | 95.91 | (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 | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 69.27 | x | 0.63 | x | 0.7 | = | 71.55 | (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 | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 44.07 | x | 0.63 | x | 0.7 | = | 45.52 | (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 | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 31.49 | x | 0.63 | x | 0.7 | = | 32.53 | (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 | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (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 | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (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 | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (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 | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (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 | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (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 | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (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 | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (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 | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (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 | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 119.01 | | 0.63 | x | 0.7 | = | 58.92 | (79) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9 | x | 0.77 | x | 1.62 | x | 119.01 | x | 0.63 | x | 0.7 | = | 58.92 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 0.66 | x | 119.01 | x | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 0.66 | x | 119.01 | x | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.62 | x | 118.15 | x | 0.63 | x | 0.7 | = | 58.5 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.62 | x | 118.15 | x | 0.63 | x | 0.7 | = | 58.5 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 0.66 | x | 118.15 | x | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.44 | x | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 0.66 | x | 118.15 | x | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.44 | x | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.62 | x | 113.91 | x | 0.63 | x | 0.7 | = | 56.4 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.62 | x | 113.91 | x | 0.63 | x | 0.7 | = | 56.4 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 0.66 | x | 113.91 | x | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 0.66 | x | 113.91 | x | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.62 | x | 104.39 | x | 0.63 | x | 0.7 | = | 51.68 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.62 | x | 104.39 | x | 0.63 | x | 0.7 | = | 51.68 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 0.66 | x | 104.39 | x | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.44 | x | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 0.66 | x | 104.39 | x | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.44 | x | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.62 | x | 92.85 | x | 0.63 | x | 0.7 | = | 45.97 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.62 | x | 92.85 | x | 0.63 | x | 0.7 | = | 45.97 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 0.66 | x | 92.85 | x | 0.63 | x | 0.7 | = | 18.73 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 0.66 | x | 92.85 | x | 0.63 | x | 0.7 | = | 18.73 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.62 | x | 69.27 | x | 0.63 | x | 0.7 | = | 34.29 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.62 | x | 69.27 | x | 0.63 | x | 0.7 | = | 34.29 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 0.66 | x | 69.27 | x | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 0.66 | x | 69.27 | x | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.62 | x | 44.07 | x | 0.63 | x | 0.7 | = | 21.82 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.62 | x | 44.07 | x | 0.63 | x | 0.7 | = | 21.82 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 0.66 | x | 44.07 | x | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 0.66 | x | 44.07 | x | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9 | x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (79) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (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 | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (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 | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (79) |
| 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 | 2.52 | x | 11.28 | x | 0.63 | x | 0.7 | = | 8.69 | (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 | 1.26 | x | 22.97 | x | 0.63 | x | 0.7 | = | 8.84 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 22.97 | x | 0.63 | x | 0.7 | = | 17.69 | (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 | 1.26 | x | 41.38 | x | 0.63 | x | 0.7 | = | 15.93 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 41.38 | x | 0.63 | x | 0.7 | = | 31.87 | (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 | 1.26 | x | 67.96 | x | 0.63 | x | 0.7 | = | 26.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 67.96 | x | 0.63 | x | 0.7 | = | 52.34 | (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 | 1.26 | x | 91.35 | x | 0.63 | x | 0.7 | = | 35.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 91.35 | x | 0.63 | x | 0.7 | = | 70.35 | (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 | 1.26 | x | 97.38 | x | 0.63 | x | 0.7 | = | 37.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 97.38 | x | 0.63 | x | 0.7 | = | 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 | 1.26 | x | 91.1 | x | 0.63 | x | 0.7 | = | 35.08 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 91.1 | x | 0.63 | x | 0.7 | = | 70.16 | (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 | 1.26 | x | 72.63 | x | 0.63 | x | 0.7 | = | 27.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 72.63 | x | 0.63 | x | 0.7 | = | 55.93 | (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 | 1.26 | x | 50.42 | x | 0.63 | x | 0.7 | = | 19.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 50.42 | x | 0.63 | x | 0.7 | = | 38.83 | (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 | 1.26 | x | 28.07 | x | 0.63 | x | 0.7 | = | 10.81 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 28.07 | x | 0.63 | x | 0.7 | = | 21.62 | (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 | 1.26 | x | 14.2 | x | 0.63 | x | 0.7 | = | 5.47 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 14.2 | x | 0.63 | x | 0.7 | = | 10.93 | (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 | 1.26 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.55 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 9.21 | x | 0.63 | x | 0.7 | = | 7.1 | (81) |

# DER WorkSheet: New dwelling design stage

| 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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 166.68 | 290.65 | 415.57 | 544.9 | 637.7 | 645.13 | 616.96 | 545.89 | 460.07 | 326.06 | 200.87 | 141.85 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 577.97 | 699.8 | 810.16 | 915.91 | 984.63 | 968.92 | 925.77 | 860.9 | 787.22 | 677.01 | 579.19 | 540.83 | (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 | 0.98 | 0.95 | 0.86 | 0.69 | 0.53 | 0.58 | 0.83 | 0.97 | 0.99 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.59 | 19.78 | 20.08 | 20.46 | 20.76 | 20.94 | 20.99 | 20.98 | 20.86 | 20.45 | 19.95 | 19.56 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.84 | 19.84 | 19.85 | 19.86 | 19.87 | 19.88 | 19.88 | 19.88 | 19.87 | 19.87 | 19.86 | 19.85 | (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 | 0.45 | 0.75 | 0.95 | 0.99 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.97 | 18.26 | 18.69 | 19.24 | 19.64 | 19.84 | 19.88 | 19.87 | 19.76 | 19.23 | 18.51 | 17.94 | (90) |

fLA = Living area ÷ (4) = 0.2 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.29 | 18.56 | 18.97 | 19.48 | 19.86 | 20.06 | 20.1 | 20.09 | 19.98 | 19.47 | 18.8 | 18.26 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.14 | 18.41 | 18.82 | 19.33 | 19.71 | 19.91 | 19.95 | 19.94 | 19.83 | 19.32 | 18.65 | 18.11 | (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 | 0.99 | 0.97 | 0.92 | 0.8 | 0.6 | 0.41 | 0.46 | 0.74 | 0.94 | 0.99 | 1 | (94) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 574.79 | 690.79 | 784.78 | 839.48 | 786.54 | 580.16 | 379.14 | 398.02 | 585.66 | 638.54 | 572.52 | 538.61 | (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= | 1651.04 | 1605.83 | 1458.53 | 1214.4 | 930.22 | 607.2 | 382.68 | 404.17 | 659.13 | 1012.69 | 1349.23 | 1636.57 | (97) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 800.73 | 614.9 | 501.27 | 269.95 | 106.9 | 0 | 0 | 0 | 0 | 278.37 | 559.23 | 816.88 | |

Total per year (kWh/year) = Sum(98)$_{1…5,9…12}$ = 3948.23 (98)

Space heating requirement in kWh/m²/year 43.15 (99)

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

**Space heating:**

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

# DER WorkSheet: New dwelling design stage

| | | |
|---|---|---|
| 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) | 800.73 | 614.9 | 501.27 | 269.95 | 106.9 | 0 | 0 | 0 | 0 | 278.37 | 559.23 | 816.88 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) (211) | 887.72 | 681.71 | 555.73 | 299.28 | 118.52 | 0 | 0 | 0 | 0 | 308.61 | 619.99 | 905.63 | |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 4377.19 (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 | |

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 192.49 | 169.33 | 177.04 | 157.61 | 153.66 | 136.17 | 129.7 | 143.81 | 144.02 | 163.49 | 174.25 | 187.49 |

Efficiency of water heater 87 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 89.56 | 89.49 | 89.34 | 88.99 | 88.28 | 87 | 87 | 87 | 87 | 88.99 | 89.42 | 89.58 | (217) |

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 214.92 | 189.21 | 198.16 | 177.11 | 174.06 | 156.52 | 149.08 | 165.3 | 165.54 | 183.72 | 194.87 | 209.29 | |

Total = Sum(219a)$_{1...12}$ = 2177.78 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 4377.19 |
| Water heating fuel used | | 2177.78 |
| 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 | | 380.71 (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 | = | 945.47 | (261) |
| Space heating (secondary) | (215) x | | 0.519 | = | 0 | (263) |
| Water heating | (219) x | | 0.216 | = | 470.4 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 1415.87 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | | 0.519 | = | 38.93 | (267) |

# DER WorkSheet: New dwelling design stage

| | | | | | | |
|---|---|---|---|---|---|---|
| Electricity for lighting | (232) | x | 0.519 | = | 197.59 | (268) |
| Energy saving/generation technologies Item 1 | | | 0.519 | = | -416.86 | (269) |
| Total CO2, kg/year | | | sum of (265)…(271) = | | 1235.53 | (272) |
| **Dwelling CO2 Emission Rate** | | | (272) ÷ (4) = | | 13.5 | (273) |
| EI rating (section 14) | | | | | 88 | (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 57

**Address :** Plot 57 , Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 45.75 (1a) | x | 2.38 (2a) | = | 108.89 | (3a) |
| Ground floor | 45.75 (1b) | x | 2.62 (2b) | = | 119.86 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 91.5 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 228.75 | (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) = | 0.13 | (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) | | | 0.38 | (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) = | | 0.38 | (21) |

Infiltration rate modified for monthly wind speed

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

# TER WorkSheet: New dwelling 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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.49 | 0.48 | 0.47 | 0.42 | 0.41 | 0.36 | 0.36 | 0.35 | 0.38 | 0.41 | 0.43 | 0.45 |

*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 | 0.61 | 0.61 | 0.59 | 0.58 | 0.57 | 0.57 | 0.56 | 0.57 | 0.58 | 0.59 | 0.6 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.62 | 0.61 | 0.61 | 0.59 | 0.58 | 0.57 | 0.57 | 0.56 | 0.57 | 0.58 | 0.59 | 0.6 |

(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 | | | 1.62 | x1/[1/( 1.4 )+ 0.04] | | = | 2.15 | | | (27) |
| Windows Type 2 | | | 1.62 | x1/[1/( 1.4 )+ 0.04] | | = | 2.15 | | | (27) |
| Windows Type 3 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 4 | | | 3.38 | x1/[1/( 1.4 )+ 0.04] | | = | 4.48 | | | (27) |
| Windows Type 5 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 6 | | | 1.26 | x1/[1/( 1.4 )+ 0.04] | | = | 1.67 | | | (27) |
| Windows Type 7 | | | 2.52 | x1/[1/( 1.4 )+ 0.04] | | = | 3.34 | | | (27) |
| Windows Type 8 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 9 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 10 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 11 | | | 1.1 | x1/[1/( 1.4 )+ 0.04] | | = | 1.46 | | | (27) |
| Windows Type 12 | | | 1.1 | x1/[1/( 1.4 )+ 0.04] | | = | 1.46 | | | (27) |
| Windows Type 13 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Floor | | | 45.75 | x | 0.13 | = | 5.9475 | | | (28) |
| Walls | 78 | 21.02 | 56.98 | x | 0.18 | = | 10.26 | | | (29) |
| Roof | 46.94 | 0 | 46.94 | x | 0.13 | = | 6.1 | | | (30) |

# TER WorkSheet: New dwelling design stage

Total area of elements, m² 170.69 (31)

** 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) = 49.91 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 7272.51 (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 10.93 (36)

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

Total fabric heat loss (33) + (36) = 60.83 (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= | 46.66 | 46.31 | 45.97 | 44.38 | 44.08 | 42.69 | 42.69 | 42.44 | 43.23 | 44.08 | 44.68 | 45.31 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 107.49 | 107.14 | 106.8 | 105.21 | 104.91 | 103.52 | 103.52 | 103.27 | 104.06 | 104.91 | 105.52 | 106.15 | |

Average = Sum(39)$_{1...12}$ /12= 105.21 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.17 | 1.17 | 1.17 | 1.15 | 1.15 | 1.13 | 1.13 | 1.13 | 1.14 | 1.15 | 1.15 | 1.16 | |

Average = Sum(40)$_{1...12}$ /12= 1.15 (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 2.65 (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 97.04 (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= | 106.74 | 102.86 | 98.98 | 95.09 | 91.21 | 87.33 | 87.33 | 91.21 | 95.09 | 98.98 | 102.86 | 106.74 | |

Total = Sum(44)$_{1...12}$ = 1164.42 (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= | 158.29 | 138.44 | 142.86 | 124.55 | 119.51 | 103.13 | 95.56 | 109.66 | 110.97 | 129.32 | 141.17 | 153.3 | |

Total = Sum(45)$_{1...12}$ = 1526.74 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.74 | 20.77 | 21.43 | 18.68 | 17.93 | 15.47 | 14.33 | 16.45 | 16.65 | 19.4 | 21.17 | 22.99 | (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)

# TER 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= | 50.96 | 46.03 | 50.44 | 46.9 | 46.48 | 43.07 | 44.5 | 46.48 | 46.9 | 50.44 | 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= | 209.25 | 184.47 | 193.3 | 171.44 | 165.99 | 146.19 | 140.06 | 156.14 | 157.86 | 179.76 | 190.48 | 204.26 | (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= | 209.25 | 184.47 | 193.3 | 171.44 | 165.99 | 146.19 | 140.06 | 156.14 | 157.86 | 179.76 | 190.48 | 204.26 | |

Output from water heater (annual)$_{1...12}$: 2099.2 (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= | 65.37 | 57.54 | 60.11 | 53.14 | 51.36 | 45.06 | 42.9 | 48.08 | 48.62 | 55.61 | 59.27 | 63.71 | (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= | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | 132.29 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 21.56 | 19.15 | 15.57 | 11.79 | 8.81 | 7.44 | 8.04 | 10.45 | 14.02 | 17.81 | 20.78 | 22.16 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 241.81 | 244.32 | 238 | 224.54 | 207.54 | 191.57 | 180.9 | 178.39 | 184.72 | 198.18 | 215.17 | 231.14 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | 36.23 | (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= | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | -105.83 | (71) |

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Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 87.86 | 85.62 | 80.79 | 73.8 | 69.03 | 62.58 | 57.66 | 64.63 | 67.53 | 74.74 | 82.31 | 85.63 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 416.92 | 414.78 | 400.05 | 375.81 | 351.07 | 327.28 | 312.29 | 319.15 | 331.96 | 356.41 | 383.95 | 404.62 | (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) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | (75) |
| Northeast 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (75) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 36.79 | x | 0.63 | x | 0.7 | = | 38.01 | (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 | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 62.67 | x | 0.63 | x | 0.7 | = | 64.74 | (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 | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 85.75 | x | 0.63 | x | 0.7 | = | 88.58 | (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 | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 106.25 | x | 0.63 | x | 0.7 | = | 109.75 | (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 | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 119.01 | x | 0.63 | x | 0.7 | = | 122.93 | (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 | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 118.15 | x | 0.63 | x | 0.7 | = | 122.05 | (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 | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 3.38 | x | 113.91 | x | 0.63 | x | 0.7 | = | 117.67 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |

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| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 3.38 | x | 104.39 | x | 0.63 | x | 0.7 | = | 107.83 | (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 | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 92.85 | x | 0.63 | x | 0.7 | = | 95.91 | (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 | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 69.27 | x | 0.63 | x | 0.7 | = | 71.55 | (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 | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 44.07 | x | 0.63 | x | 0.7 | = | 45.52 | (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 | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 3.38 | x | 31.49 | x | 0.63 | x | 0.7 | = | 32.53 | (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 | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (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 | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (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 | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (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 | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (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 | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (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 | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (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 | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (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 | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (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 | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 119.01 | | 0.63 | x | 0.7 | = | 58.92 | (79) |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 119.01 | | 0.63 | x | 0.7 | = | 58.92 | (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 | 1.44 | x | 119.01 | | 0.63 | x | 0.7 | = | 52.37 | (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 | 1.44 | x | 119.01 | | 0.63 | x | 0.7 | = | 52.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 118.15 | | 0.63 | x | 0.7 | = | 58.5 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 118.15 | | 0.63 | x | 0.7 | = | 58.5 | (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 | 1.44 | x | 118.15 | | 0.63 | x | 0.7 | = | 52 | (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 | 1.44 | x | 118.15 | | 0.63 | x | 0.7 | = | 52 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 113.91 | | 0.63 | x | 0.7 | = | 56.4 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 113.91 | | 0.63 | x | 0.7 | = | 56.4 | (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 | 1.44 | x | 113.91 | | 0.63 | x | 0.7 | = | 50.13 | (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 | 1.44 | x | 113.91 | | 0.63 | x | 0.7 | = | 50.13 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 104.39 | | 0.63 | x | 0.7 | = | 51.68 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 104.39 | | 0.63 | x | 0.7 | = | 51.68 | (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 | 1.44 | x | 104.39 | | 0.63 | x | 0.7 | = | 45.94 | (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 | 1.44 | x | 104.39 | | 0.63 | x | 0.7 | = | 45.94 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 92.85 | | 0.63 | x | 0.7 | = | 45.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 92.85 | | 0.63 | x | 0.7 | = | 45.97 | (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 | 1.44 | x | 92.85 | | 0.63 | x | 0.7 | = | 40.86 | (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 | 1.44 | x | 92.85 | | 0.63 | x | 0.7 | = | 40.86 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 69.27 | | 0.63 | x | 0.7 | = | 34.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 69.27 | | 0.63 | x | 0.7 | = | 34.29 | (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 | 1.44 | x | 69.27 | | 0.63 | x | 0.7 | = | 30.48 | (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 | 1.44 | x | 69.27 | | 0.63 | x | 0.7 | = | 30.48 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 44.07 | | 0.63 | x | 0.7 | = | 21.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 44.07 | | 0.63 | x | 0.7 | = | 21.82 | (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 | 1.44 | x | 44.07 | | 0.63 | x | 0.7 | = | 19.39 | (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 | 1.44 | x | 44.07 | | 0.63 | x | 0.7 | = | 19.39 | (79) |

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| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (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 | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (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 | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (79) |
| 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 | 2.52 | x | 11.28 | x | 0.63 | x | 0.7 | = | 8.69 | (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 | 1.26 | x | 22.97 | x | 0.63 | x | 0.7 | = | 8.84 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 22.97 | x | 0.63 | x | 0.7 | = | 17.69 | (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 | 1.26 | x | 41.38 | x | 0.63 | x | 0.7 | = | 15.93 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 41.38 | x | 0.63 | x | 0.7 | = | 31.87 | (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 | 1.26 | x | 67.96 | x | 0.63 | x | 0.7 | = | 26.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 67.96 | x | 0.63 | x | 0.7 | = | 52.34 | (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 | 1.26 | x | 91.35 | x | 0.63 | x | 0.7 | = | 35.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 91.35 | x | 0.63 | x | 0.7 | = | 70.35 | (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 | 1.26 | x | 97.38 | x | 0.63 | x | 0.7 | = | 37.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 97.38 | x | 0.63 | x | 0.7 | = | 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 | 1.26 | x | 91.1 | x | 0.63 | x | 0.7 | = | 35.08 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 91.1 | x | 0.63 | x | 0.7 | = | 70.16 | (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 | 1.26 | x | 72.63 | x | 0.63 | x | 0.7 | = | 27.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 72.63 | x | 0.63 | x | 0.7 | = | 55.93 | (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 | 1.26 | x | 50.42 | x | 0.63 | x | 0.7 | = | 19.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 50.42 | x | 0.63 | x | 0.7 | = | 38.83 | (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 | 1.26 | x | 28.07 | x | 0.63 | x | 0.7 | = | 10.81 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 28.07 | x | 0.63 | x | 0.7 | = | 21.62 | (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 | 1.26 | x | 14.2 | x | 0.63 | x | 0.7 | = | 5.47 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 14.2 | x | 0.63 | x | 0.7 | = | 10.93 | (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 | 1.26 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.55 | (81) |
| Northwest | 0.9x | 0.77 | x | 2.52 | x | 9.21 | x | 0.63 | x | 0.7 | = | 7.1 | (81) |

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| 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= | 166.68 | 290.65 | 415.57 | 544.9 | 637.7 | 645.13 | 616.96 | 545.89 | 460.07 | 326.06 | 200.87 | 141.85 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 583.6 | 705.43 | 815.62 | 920.71 | 988.77 | 972.4 | 929.25 | 865.04 | 792.03 | 682.47 | 584.83 | 546.47 | (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 | 0.98 | 0.94 | 0.83 | 0.65 | 0.48 | 0.54 | 0.79 | 0.96 | 0.99 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.76 | 19.95 | 20.23 | 20.58 | 20.84 | 20.97 | 20.99 | 20.99 | 20.91 | 20.55 | 20.09 | 19.73 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.94 | 19.94 | 19.95 | 19.96 | 19.96 | 19.98 | 19.98 | 19.98 | 19.97 | 19.96 | 19.96 | 19.95 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.97 | 0.91 | 0.78 | 0.56 | 0.37 | 0.42 | 0.71 | 0.95 | 0.99 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.29 | 18.58 | 18.98 | 19.48 | 19.81 | 19.95 | 19.97 | 19.97 | 19.9 | 19.46 | 18.79 | 18.26 | (90) |

fLA = Living area ÷ (4) = 0.2 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.59 | 18.85 | 19.23 | 19.7 | 20.02 | 20.15 | 20.18 | 20.18 | 20.1 | 19.67 | 19.05 | 18.55 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.59 | 18.85 | 19.23 | 19.7 | 20.02 | 20.15 | 20.18 | 20.18 | 20.1 | 19.67 | 19.05 | 18.55 | (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 | 0.99 | 0.97 | 0.91 | 0.78 | 0.57 | 0.4 | 0.45 | 0.72 | 0.94 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 580.55 | 696.29 | 788.56 | 836.17 | 769.42 | 558.17 | 368.12 | 386.16 | 572.54 | 640.75 | 578.1 | 544.36 | (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= | 1535.58 | 1494.59 | 1359.81 | 1135.86 | 872.45 | 575.05 | 370.18 | 389.86 | 624.3 | 951.97 | 1260.82 | 1523.54 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 710.54 | 536.45 | 425.01 | 215.78 | 76.65 | 0 | 0 | 0 | 0 | 231.55 | 491.55 | 728.51 | |

Total per year (kWh/year) = Sum(98)$_{1…5,9…12}$ = 3416.04 (98)

Space heating requirement in kWh/m²/year 37.33 (99)

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

**Space heating:**

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

# TER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| 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) | 710.54 | 536.45 | 425.01 | 215.78 | 76.65 | 0 | 0 | 0 | 0 | 231.55 | 491.55 | 728.51 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 760.75 | 574.36 | 455.04 | 231.03 | 82.07 | 0 | 0 | 0 | 0 | 247.91 | 526.29 | 779.99 | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | | | | | | | | | | | | | 3657.43 (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 | |
| Total (kWh/year) =Sum(215)$_{1...5,10...12}$= | | | | | | | | | | | | | 0 (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 209.25 | 184.47 | 193.3 | 171.44 | 165.99 | 146.19 | 140.06 | 156.14 | 157.86 | 179.76 | 190.48 | 204.26 | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 (216) |
| (217)m= | 87.89 | 87.58 | 86.98 | 85.63 | 83.24 | 80.3 | 80.3 | 80.3 | 80.3 | 85.69 | 87.33 | 87.98 | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | |
| (219)m= | 238.09 | 210.63 | 222.23 | 200.21 | 199.41 | 182.06 | 174.43 | 194.44 | 196.59 | 209.78 | 218.11 | 232.17 | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2478.16 (219) |

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 3657.43 |
| Water heating fuel used | | 2478.16 |
| 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 | | 380.71 (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 | = | 790.01 | (261) |
| Space heating (secondary) | (215) x | | 0.519 | = | 0 | (263) |
| Water heating | (219) x | | 0.216 | = | 535.28 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 1325.29 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | | 0.519 | = | 197.59 | (268) |

# TER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Total CO2, kg/year | sum of (265)…(271) = | 1561.8 | (272) |
| **TER =** | | 17.07 | (273) |

# SAP 2012 Overheating Assessment

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

## Property Details: Plot 57

| | |
|---|---|
| **Dwelling type:** | Detached House |
| **Located in:** | England |
| **Region:** | East Pennines |
| **Cross ventilation possible:** | Yes |
| **Number of storeys:** | 2 |
| **Front of dwelling faces:** | South West |
| **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:** | 226.46 | **(P1)** |
| **Transmission heat loss coefficient:** | 70.5 | |
| **Summer heat loss coefficient:** | 296.93 | **(P2)** |

## Overhangs:

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

## Solar shading:

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

## Solar gains:

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

# SAP 2012 Overheating Assessment

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| South West (Dining) | 0.9 x | 1.62 | 113.91 | 0.63 | 0.7 | 0.9 | 65.92 | |
| South West (Living Room) | 0.9 x | 1.62 | 113.91 | 0.63 | 0.7 | 0.9 | 65.92 | |
| South West (Living Bay 1) | 0.9 x | 0.66 | 113.91 | 0.63 | 0.7 | 0.9 | 26.86 | |
| South East (Living Bay 2) | 0.9 x | 3.38 | 113.91 | 0.63 | 0.7 | 0.9 | 137.53 | |
| North East (Living Bay 3) | 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 | |
| North West (Dining) | 0.9 x | 2.52 | 91.1 | 0.63 | 0.7 | 0.9 | 82.01 | |
| South West (Bedroom 2) | 0.9 x | 1.44 | 113.91 | 0.63 | 0.7 | 0.9 | 58.59 | |
| South West (En Suite) | 0.9 x | 0.66 | 113.91 | 0.63 | 0.7 | 0.9 | 26.86 | |
| South West (Bedroom 1) | 0.9 x | 1.44 | 113.91 | 0.63 | 0.7 | 0.9 | 58.59 | |
| South East (Bedroom 1 2) | 0.9 x | 1.1 | 113.91 | 0.63 | 0.7 | 0.9 | 44.76 | |
| South East (Bath) | 0.9 x | 1.1 | 113.91 | 0.63 | 0.7 | 0.9 | 44.76 | |
| North West (Bedroom 3) | 0.9 x | 1.44 | 91.1 | 0.63 | 0.7 | 0.9 | 46.86 | |
| | | | | | | **Total** | 721.13 | **(P3/P4)** |

## Internal gains:

| | **June** | **July** | **August** | |
|---|---|---|---|---|
| Internal gains | 470.06 | 450.71 | 459.3 | |
| Total summer gains | 1224.11 | 1171.84 | 1097.35 | **(P5)** |
| Summer gain/loss ratio | 4.12 | 3.95 | 3.7 | **(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 | 18.97 | 20.8 | 20.35 | **(P7)** |
| **Likelihood of high internal temperature** | **Not significant** | **Slight** | **Not significant** | |

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