# 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 12:01:19 PM*

## Project Information:

**Assessed By:** Chloe Hewitt (STRO029693) **Building Type:** End-terrace House

## Dwelling Details:

**NEW DWELLING DESIGN STAGE** Total Floor Area: 60.54m²

**Site Reference :** Wardentree Lane **Plot Reference:** Plot 75

**Address :** Plot 75, 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) | 20.08 kg/m² | |
| Dwelling Carbon Dioxide Emission Rate (DER) | 14.10 kg/m² | **OK** |

## 1b TFEE and DFEE

| | | |
|---|---|---|
| Target Fabric Energy Efficiency (TFEE) | 54.0 kWh/m² | |
| Dwelling Fabric Energy Efficiency (DFEE) | 51.5 kWh/m² | |
| | | **OK** |

## 2 Fabric U-values

| Element | Average | Highest | |
|---|---|---|---|
| External wall | 0.22 (max. 0.30) | 0.22 (max. 0.70) | **OK** |
| Party wall | 0.00 (max. 0.20) | - | **OK** |
| Floor | 0.12 (max. 0.25) | 0.12 (max. 0.70) | **OK** |
| Roof | 0.09 (max. 0.20) | 0.09 (max. 0.35) | **OK** |
| Openings | 1.34 (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): | Not significant | OK |

Based on:

| | |
|---|---|
| Overshading: | Average or unknown |
| Windows facing: North West | 1.62m² |
| Windows facing: South East | 3.78m² |
| Windows facing: South East | 1.44m² |
| Windows facing: North West | 1.44m² |
| Ventilation rate: | 3.00 |
| Blinds/curtains: | |
| | Closed 100% of daylight hours |

## 10 Key features

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

# Thermal Bridge Report

## Property Details: Plot 75

| | |
|---|---|
| Address: | Plot 75, 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 = 0.0867

## External Junctions Details:

| Junction Type | PSI-Value | Length | Reference | Type |
|---|---|---|---|---|
| Steel lintel with perforated steel base plate | 0.5 | 6.41 | E1 | [A] |
| Sill | 0.04 | 3.6 | E3 | [A] |
| Jamb | 0.05 | 15.9 | E4 | [A] |
| Ground floor (normal) | 0.16 | 17.3 | E5 | [A] |
| Eaves (insulation at ceiling level) | 0.06 | 7.52 | E10 | [A] |
| Gable (insulation at ceiling level) | 0.24 | 8.05 | E12 | [A] |
| Corner (normal) | 0.09 | 10.02 | E16 | [A] |
| Intermediate floor within a dwelling | 0.07 | 17.3 | E6 | [A] |
| Party wall between dwellings | 0.06 | 10.02 | E18 | [A] |

## Party Junctions Details:

| | | | | |
|---|---|---|---|---|
| Ground floor | 0 | 8.05 | P1 | [UD] |
| Intermediate floor within a dwelling | 0 | 8.05 | P2 | [UD] |
| Roof (insulation at ceiling level) | 0 | 8.05 | P4 | [UD] |

# SAP Input

## Property Details: Plot 75

| | |
|---|---|
| Address: | Plot 75, 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: | End-terrace |
| Year Completed: | 2016 |

| Floor Location: | Floor area: | Storey height: |
|---|---|---|
| Basement floor | 30.27 m² | 2.4 m |
| Floor 1 | 30.27 m² | 2.61 m |

| | |
|---|---|
| Living area: | 15.55 m² (fraction 0.257) |
| Front of dwelling faces: | North West |

## Opening types:

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

| **Name:** | **Gap:** | **Frame Factor:** | **g-value:** | **U-value:** | **Area:** | **No. of Openings:** |
|---|---|---|---|---|---|---|
| Front Door | 16mm or more mm | 0.7 | 0.63 | 1 | 2.12 | 1 |
| Living Room | 16mm or more | 0.7 | 0.63 | 1.43 | 1.62 | 1 |
| Kitchen Doors | 16mm or more | 0.7 | 0.63 | 1.43 | 3.78 | 1 |
| Bedroom 1 | 16mm or more | 0.7 | 0.63 | 1.43 | 1.44 | 1 |
| Bedroom 2 | 16mm or more | 0.7 | 0.63 | 1.43 | 1.44 | 1 |

| Name: | Type-Name: | Location: | Orient: | Width: | Height: |
|---|---|---|---|---|---|
| Front Door | | External Wall | North West | 1.01 | 2.1 |
| Living Room | | External Wall | North West | 1.2 | 1.35 |
| Kitchen Doors | | External Wall | South East | 1.8 | 2.1 |
| Bedroom 1 | | External Wall | South East | 1.2 | 1.2 |
| Bedroom 2 | | External Wall | North West | 1.2 | 1.2 |

| | |
|---|---|
| Overshading: | Average or unknown |

## Opaque Elements:

| Type: | Gross area: | Openings: | Net area: | U-value: | Ru value: | Curtain wall: | Kappa: |
|---|---|---|---|---|---|---|---|
| External Elements | | | | | | | |
| External Wall | 78 | 10.4 | 67.6 | 0.22 | 0 | False | N/A |
| Main Roof | 30.27 | 0 | 30.27 | 0.09 | 0 | | N/A |
| Ground Floor | 30.27 | | | 0.12 | | | N/A |

# SAP Input

Internal Elements

Party Elements

| | | |
|---|---|---|
| Party Wall | 40.41 | N/A |

## Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0867

| | Length | Psi-value | | |
|---|---|---|---|---|
| [Approved] | 6.41 | 0.5 | E1 | Steel lintel with perforated steel base plate |
| [Approved] | 3.6 | 0.04 | E3 | Sill |
| [Approved] | 15.9 | 0.05 | E4 | Jamb |
| [Approved] | 17.3 | 0.16 | E5 | Ground floor (normal) |
| [Approved] | 7.52 | 0.06 | E10 | Eaves (insulation at ceiling level) |
| [Approved] | 8.05 | 0.24 | E12 | Gable (insulation at ceiling level) |
| [Approved] | 10.02 | 0.09 | E16 | Corner (normal) |
| [Approved] | 17.3 | 0.07 | E6 | Intermediate floor within a dwelling |
| [Approved] | 10.02 | 0.06 | E18 | Party wall between dwellings |
| | 8.05 | 0 | P1 | Ground floor |
| | 8.05 | 0 | P2 | Intermediate floor within a dwelling |
| | 8.05 | 0 | P4 | Roof (insulation at ceiling level) |

## Ventilation:

Pressure test: Yes (As designed)
Ventilation: Natural ventilation (extract fans)
Number of chimneys: 0
Number of open flues: 0
Number of fans: 3
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
Database: (rev 404, product index 017688) Efficiency: Winter 87.0 % Summer: 90.2
Brand name: Vaillant
Model: ecoTEC pro 30 H combi A
Model qualifier: VUW GB 306/5-3
(Combi boiler)
Systems with radiators
Central heating pump : 2013 or later
Design flow temperature: Unknown
Boiler interlock: Yes
Delayed start

## Main heating Control:

Main heating Control:
Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2110

## Secondary heating system:

Secondary heating system: None

## Water heating:

Water heating:
From main heating system
Water code: 901
Fuel :mains gas
No hot water cylinder
Solar panel: False

# SAP Input

## Others:

| | |
|---|---|
| Electricity tariff: | Standard Tariff |
| In Smoke Control Area: | No |
| Conservatory: | No conservatory |
| Low energy lights: | 100% |
| Terrain type: | Low rise urban / suburban |
| EPC language: | English |
| Wind turbine: | No |
| Photovoltaics: | Photovoltaic 1<br>Installed Peak power: 1<br>Tilt of collector: 45°<br>Overshading: None or very little<br>Collector Orientation: South East |
| Assess Zero Carbon Home: | No |

# SAP WorkSheet: New dwelling design stage

## User Details:

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

## Property Address: Plot 75

**Address :** Plot 75, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 30.27 (1a) | x | 2.4 (2a) | = | 72.65 | (3a) |
| Ground floor | 30.27 (1b) | x | 2.61 (2b) | = | 79 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 60.54 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 151.65 | (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) = | 0.2 (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) | | 0.45 (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) = | | 0.45 (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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.57 | 0.56 | 0.55 | 0.49 | 0.48 | 0.43 | 0.43 | 0.41 | 0.45 | 0.48 | 0.5 | 0.53 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

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

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

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

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

(24a)

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

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

(24b)

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

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

(24c)

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

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

(24d)

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

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

(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 | | | 3.78 | x | 1/[1/( 1.43 )+ 0.04] | = | 5.11 | | | (27) |
| Windows Type 3 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 4 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Floor | | | 30.27 | x | 0.12 | = | 3.6324 | | | (28) |
| Walls | 78 | 10.4 | 67.6 | x | 0.22 | = | 14.87 | | | (29) |
| Roof | 30.27 | 0 | 30.27 | x | 0.09 | = | 2.72 | | | (30) |
| Total area of elements, m² | | | 138.54 | | | | | | | (31) |
| Party wall | | | 40.41 | x | 0 | = | 0 | | | (32) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.55 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 8417.13 (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 12.01 (36)

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

Total fabric heat loss (33) + (36) = 46.56 (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= | 33.18 | 32.86 | 32.55 | 31.09 | 30.82 | 29.55 | 29.55 | 29.32 | 30.04 | 30.82 | 31.37 | 31.95 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 79.74 | 79.42 | 79.11 | 77.65 | 77.38 | 76.11 | 76.11 | 75.87 | 76.6 | 77.38 | 77.93 | 78.51 | |

Average = Sum(39)$_{1...12}$ /12= 77.65 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.32 | 1.31 | 1.31 | 1.28 | 1.28 | 1.26 | 1.26 | 1.25 | 1.27 | 1.28 | 1.29 | 1.3 | |

Average = Sum(40)$_{1...12}$ /12= 1.28 (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 (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 81.63 (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= | 89.79 | 86.52 | 83.26 | 79.99 | 76.73 | 73.46 | 73.46 | 76.73 | 79.99 | 83.26 | 86.52 | 89.79 | |

Total = Sum(44)$_{1...12}$ = 979.51 (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= | 133.15 | 116.46 | 120.17 | 104.77 | 100.53 | 86.75 | 80.39 | 92.24 | 93.35 | 108.78 | 118.75 | 128.95 | |

Total = Sum(45)$_{1...12}$ = 1284.29 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 19.97 | 17.47 | 18.03 | 15.72 | 15.08 | 13.01 | 12.06 | 13.84 | 14 | 16.32 | 17.81 | 19.34 | (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)

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)

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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= | 34.17 | 30.85 | 34.15 | 33.04 | 34.13 | 33.02 | 34.12 | 34.13 | 33.03 | 34.14 | 33.05 | 34.16 | (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= | 167.32 | 147.31 | 154.32 | 137.81 | 134.66 | 119.77 | 114.5 | 126.37 | 126.38 | 142.93 | 151.8 | 163.11 | (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= | 167.32 | 147.31 | 154.32 | 137.81 | 134.66 | 119.77 | 114.5 | 126.37 | 126.38 | 142.93 | 151.8 | 163.11 | |

Output from water heater (annual)$_{1...12}$ 1686.28 (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= | 52.81 | 46.44 | 48.49 | 43.1 | 41.96 | 37.1 | 35.26 | 39.2 | 39.29 | 44.71 | 47.75 | 51.42 | (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= | 119.81 | 119.81 | 119.81 | 119.81 | 119.81 | 119.81 | 119.81 | 119.81 | 119.81 | 119.81 | 119.81 | 119.81 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 39.99 | 35.52 | 28.89 | 21.87 | 16.35 | 13.8 | 14.91 | 19.38 | 26.02 | 33.04 | 38.56 | 41.1 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 260.16 | 262.86 | 256.06 | 241.57 | 223.29 | 206.11 | 194.63 | 191.93 | 198.73 | 213.22 | 231.5 | 248.68 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 48.98 | 48.98 | 48.98 | 48.98 | 48.98 | 48.98 | 48.98 | 48.98 | 48.98 | 48.98 | 48.98 | 48.98 | (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= | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 70.99 | 69.1 | 65.18 | 59.85 | 56.4 | 51.53 | 47.39 | 52.69 | 54.58 | 60.09 | 66.31 | 69.11 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 463.05 | 459.4 | 442.04 | 415.21 | 387.95 | 363.35 | 348.85 | 355.92 | 371.24 | 398.26 | 428.29 | 450.81 | (73) |

## 6. Solar gains:

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

# SAP WorkSheet: New dwelling design stage

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 3.78 | x | 36.79 | x | 0.63 | x | 0.7 | = | 42.5 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 62.67 | x | 0.63 | x | 0.7 | = | 72.4 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 85.75 | x | 0.63 | x | 0.7 | = | 99.06 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 106.25 | x | 0.63 | x | 0.7 | = | 122.74 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 119.01 | x | 0.63 | x | 0.7 | = | 137.48 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 118.15 | x | 0.63 | x | 0.7 | = | 136.49 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 113.91 | x | 0.63 | x | 0.7 | = | 131.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 104.39 | x | 0.63 | x | 0.7 | = | 120.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 92.85 | x | 0.63 | x | 0.7 | = | 107.26 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 69.27 | x | 0.63 | x | 0.7 | = | 80.02 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 44.07 | x | 0.63 | x | 0.7 | = | 50.91 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 31.49 | x | 0.63 | x | 0.7 | = | 36.38 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Northwest 0.9x | 0.77 | x | 1.62 | x | 11.28 | x | 0.63 | x | 0.7 | = | 5.59 | (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 | 1.62 | x | 22.97 | x | 0.63 | x | 0.7 | = | 11.37 | (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 | 1.62 | x | 41.38 | x | 0.63 | x | 0.7 | = | 20.49 | (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 | 1.62 | x | 67.96 | x | 0.63 | x | 0.7 | = | 33.64 | (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 | 1.62 | x | 91.35 | x | 0.63 | x | 0.7 | = | 45.22 | (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 | 1.62 | x | 97.38 | x | 0.63 | x | 0.7 | = | 48.21 | (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 | 1.62 | x | 91.1 | x | 0.63 | x | 0.7 | = | 45.1 | (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 | 1.62 | x | 72.63 | x | 0.63 | x | 0.7 | = | 35.96 | (81) |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 1.62 | x | 50.42 | x | 0.63 | x | 0.7 | = | 24.96 | (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 | 1.62 | x | 28.07 | x | 0.63 | x | 0.7 | = | 13.9 | (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 | 1.62 | x | 14.2 | x | 0.63 | x | 0.7 | = | 7.03 | (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 | 1.62 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.56 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 69.25 | 121.46 | 175.5 | 233.05 | 275.28 | 279.56 | 266.91 | 234.45 | 195.28 | 136.75 | 83.58 | 58.85 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 532.3 | 580.86 | 617.54 | 648.27 | 663.23 | 642.91 | 615.76 | 590.37 | 566.52 | 535.01 | 511.87 | 509.66 | (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 | 0.97 | 0.94 | 0.85 | 0.69 | 0.53 | 0.57 | 0.79 | 0.94 | 0.98 | 0.99 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.79 | 19.93 | 20.17 | 20.5 | 20.77 | 20.94 | 20.99 | 20.98 | 20.88 | 20.55 | 20.12 | 19.77 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.83 | 19.83 | 19.84 | 19.85 | 19.86 | 19.87 | 19.87 | 19.88 | 19.87 | 19.86 | 19.85 | 19.84 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.99 | 0.98 | 0.96 | 0.91 | 0.8 | 0.6 | 0.4 | 0.44 | 0.71 | 0.92 | 0.98 | 0.99 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.26 | 18.47 | 18.82 | 19.28 | 19.64 | 19.83 | 19.87 | 19.87 | 19.78 | 19.36 | 18.76 | 18.24 | (90) |

fLA = Living area ÷ (4) = 0.26 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.65 | 18.85 | 19.17 | 19.59 | 19.93 | 20.12 | 20.16 | 20.16 | 20.06 | 19.66 | 19.11 | 18.63 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.5 | 18.7 | 19.02 | 19.44 | 19.78 | 19.97 | 20.01 | 20.01 | 19.91 | 19.51 | 18.96 | 18.48 | (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 | 0.95 | 0.9 | 0.8 | 0.61 | 0.42 | 0.46 | 0.71 | 0.91 | 0.97 | 0.98 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 522.82 | 564.97 | 588.18 | 585.22 | 528.51 | 389.28 | 256.63 | 269.53 | 403.48 | 486.21 | 496.18 | 502 | (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= | 1132.27 | 1095.71 | 990.12 | 818.66 | 624.98 | 408.57 | 259.26 | 273.55 | 445.13 | 689.71 | 924.02 | 1121.44 | (97) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 453.43 | 356.66 | 299.04 | 168.08 | 71.77 | 0 | 0 | 0 | 0 | 151.41 | 308.05 | 460.87 |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2269.31 (98)

Space heating requirement in kWh/m²/year 37.48 (99)

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

**Space heating:**

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

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

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

Efficiency of main space heating system 1 90.2 (206)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 453.43 | 356.66 | 299.04 | 168.08 | 71.77 | 0 | 0 | 0 | 0 | 151.41 | 308.05 | 460.87 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 502.7 | 395.41 | 331.53 | 186.34 | 79.57 | 0 | 0 | 0 | 0 | 167.86 | 341.52 | 510.94 | (211) |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2515.86 (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)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 167.32 | 147.31 | 154.32 | 137.81 | 134.66 | 119.77 | 114.5 | 126.37 | 126.38 | 142.93 | 151.8 | 163.11 |

Efficiency of water heater 87 (216)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 89.31 | 89.24 | 89.08 | 88.73 | 88.09 | 87 | 87 | 87 | 87 | 88.62 | 89.12 | 89.34 |

(217)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 187.34 | 165.07 | 173.23 | 155.31 | 152.87 | 137.67 | 131.61 | 145.25 | 145.26 | 161.29 | 170.34 | 182.58 |

Total = Sum(219a)$_{1...12}$ = 1907.82 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 2515.86 |
| Water heating fuel used | | 1907.82 |
| 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 | | 282.51 (232) |
| Electricity generated by PVs | | -803.2 (233) |

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

# SAP WorkSheet: New dwelling design stage

| | Fuel kWh/year | | Fuel Price (Table 12) | | Fuel Cost £/year | |
|---|---|---|---|---|---|---|
| Space heating - main system 1 | (211) x | | 3.48 | x 0.01 = | 87.55 | (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 = | 66.39 | (247) |
| Pumps, fans and electric keep-hot | (231) | | 13.19 | x 0.01 = | 9.89 | (249) |
| (if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a | | | | | | |
| Energy for lighting | (232) | | 13.19 | x 0.01 = | 37.26 | (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) = | | | | 215.16 | (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] = | 0.86 | (257) |
| **SAP rating (Section 12)** | 88.06 | (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 | = | 543.43 | (261) |
| Space heating (secondary) | (215) x | | 0.519 | = | 0 | (263) |
| Water heating | (219) x | | 0.216 | = | 412.09 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 955.51 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | | 0.519 | = | 146.62 | (268) |
| Energy saving/generation technologies | | | | | | |
| Item 1 | | | 0.519 | = | -416.86 | (269) |
| Total CO2, kg/year | sum of (265)…(271) = | | | | 724.2 | (272) |
| **CO2 emissions per m²** | (272) ÷ (4) = | | | | 11.96 | (273) |
| EI rating (section 14) | | | | | 91 | (274) |

## 13a. Primary Energy

| | Energy kWh/year | | Primary factor | | P. Energy kWh/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | | 1.22 | = | 3069.35 | (261) |
| Space heating (secondary) | (215) x | | 3.07 | = | 0 | (263) |
| Energy for water heating | (219) x | | 1.22 | = | 2327.53 | (264) |

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| | | | | | |
|---|---|---|---|---|---|
| Space and water heating | (261) + (262) + (263) + (264) = | | | 5396.89 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 3.07 | = | 230.25 | (267) |
| Electricity for lighting | (232) x | 0 | = | 867.31 | (268) |
| Energy saving/generation technologies Item 1 | | 3.07 | = | -2465.81 | (269) |
| ‘Total Primary Energy | sum of (265)…(271) = | | | 4028.63 | (272) |
| **Primary energy kWh/m²/year** | (272) ÷ (4) = | | | 66.54 | (273) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

## User Details:

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

## Property Address: Plot 75

**Address :** Plot 75, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 30.27 | (1a) x | 2.4 | (2a) = | 72.65 | (3a) |
| Ground floor | 30.27 | (1b) x | 2.61 | (2b) = | 79 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 60.54 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 151.65 | (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 | | | | | | | 2 | x 10 = | 20 | (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) = | 20 | ÷ (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 | | | 3.78 | x1/[1/( 1.4 )+ 0.04] | | = | 5.01 | | | (27) |
| Windows Type 3 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 4 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Floor | | | 30.27 | x | 0.13 | = | 3.9351 | | | (28) |
| Walls | 78 | 10.4 | 67.6 | x | 0.18 | = | 12.17 | | | (29) |
| Roof | 30.27 | 0 | 30.27 | x | 0.13 | = | 3.94 | | | (30) |
| Total area of elements, m² | | | 138.54 | | | | | | | (31) |
| Party wall | | | 40.41 | x | 0 | = | 0 | | | (32) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.56 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 8417.13 (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 8.11 (36)

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

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

Total fabric heat loss (33) + (36) = 41.67 (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= | 30.95 | 30.72 | 30.5 | 29.44 | 29.24 | 28.32 | 28.32 | 28.14 | 28.67 | 29.24 | 29.64 | 30.06 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 72.62 | 72.39 | 72.17 | 71.11 | 70.91 | 69.99 | 69.99 | 69.82 | 70.34 | 70.91 | 71.31 | 71.73 | |

Average = Sum(39)$_{1...12}$ /12= 71.11 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.2 | 1.2 | 1.19 | 1.17 | 1.17 | 1.16 | 1.16 | 1.15 | 1.16 | 1.17 | 1.18 | 1.18 | |

Average = Sum(40)$_{1...12}$ /12= 1.17 (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 (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 81.63 (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= | 89.79 | 86.52 | 83.26 | 79.99 | 76.73 | 73.46 | 73.46 | 76.73 | 79.99 | 83.26 | 86.52 | 89.79 | |

Total = Sum(44)$_{1...12}$ = 979.51 (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= | 133.15 | 116.46 | 120.17 | 104.77 | 100.53 | 86.75 | 80.39 | 92.24 | 93.35 | 108.78 | 118.75 | 128.95 | |

Total = Sum(45)$_{1...12}$ = 1284.29 (45)

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

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

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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)

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

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= | 113.18 | 98.99 | 102.15 | 89.05 | 85.45 | 73.74 | 68.33 | 78.41 | 79.34 | 92.47 | 100.93 | 109.61 | (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= | 113.18 | 98.99 | 102.15 | 89.05 | 85.45 | 73.74 | 68.33 | 78.41 | 79.34 | 92.47 | 100.93 | 109.61 | |

Output from water heater (annual)$_{1...12}$ 1091.64 (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= | 28.3 | 24.75 | 25.54 | 22.26 | 21.36 | 18.43 | 17.08 | 19.6 | 19.84 | 23.12 | 25.23 | 27.4 | (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= | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 16 | 14.21 | 11.56 | 8.75 | 6.54 | 5.52 | 5.97 | 7.75 | 10.41 | 13.21 | 15.42 | 16.44 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 174.31 | 176.12 | 171.56 | 161.85 | 149.61 | 138.09 | 130.4 | 128.59 | 133.15 | 142.85 | 155.1 | 166.62 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | (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= | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 38.03 | 36.83 | 34.32 | 30.92 | 28.71 | 25.6 | 22.96 | 26.35 | 27.55 | 31.07 | 35.05 | 36.83 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 281.29 | 280.1 | 270.39 | 254.48 | 237.81 | 222.17 | 212.28 | 215.65 | 224.06 | 240.09 | 258.53 | 272.84 | (73) |

## 6. Solar gains:

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

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 3.78 | x | 36.79 | x | 0.63 | x | 0.7 | = | 42.5 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 62.67 | x | 0.63 | x | 0.7 | = | 72.4 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 85.75 | x | 0.63 | x | 0.7 | = | 99.06 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 106.25 | x | 0.63 | x | 0.7 | = | 122.74 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 119.01 | x | 0.63 | x | 0.7 | = | 137.48 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 118.15 | x | 0.63 | x | 0.7 | = | 136.49 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 113.91 | x | 0.63 | x | 0.7 | = | 131.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 104.39 | x | 0.63 | x | 0.7 | = | 120.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 92.85 | x | 0.63 | x | 0.7 | = | 107.26 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 69.27 | x | 0.63 | x | 0.7 | = | 80.02 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 44.07 | x | 0.63 | x | 0.7 | = | 50.91 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 31.49 | x | 0.63 | x | 0.7 | = | 36.38 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Northwest 0.9x | 0.77 | x | 1.62 | x | 11.28 | x | 0.63 | x | 0.7 | = | 5.59 | (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 | 1.62 | x | 22.97 | x | 0.63 | x | 0.7 | = | 11.37 | (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 | 1.62 | x | 41.38 | x | 0.63 | x | 0.7 | = | 20.49 | (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 | 1.62 | x | 67.96 | x | 0.63 | x | 0.7 | = | 33.64 | (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 | 1.62 | x | 91.35 | x | 0.63 | x | 0.7 | = | 45.22 | (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 | 1.62 | x | 97.38 | x | 0.63 | x | 0.7 | = | 48.21 | (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 | 1.62 | x | 91.1 | x | 0.63 | x | 0.7 | = | 45.1 | (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 | 1.62 | x | 72.63 | x | 0.63 | x | 0.7 | = | 35.96 | (81) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 1.62 | x | 50.42 | x | 0.63 | x | 0.7 | = | 24.96 | (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 | 1.62 | x | 28.07 | x | 0.63 | x | 0.7 | = | 13.9 | (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 | 1.62 | x | 14.2 | x | 0.63 | x | 0.7 | = | 7.03 | (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 | 1.62 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.56 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 69.25 | 121.46 | 175.5 | 233.05 | 275.28 | 279.56 | 266.91 | 234.45 | 195.28 | 136.75 | 83.58 | 58.85 | (83) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 350.54 | 401.56 | 445.89 | 487.53 | 513.09 | 501.73 | 479.19 | 450.1 | 419.34 | 376.84 | 342.11 | 331.69 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.97 | 0.92 | 0.78 | 0.62 | 0.67 | 0.89 | 0.98 | 1 | 1 | (86) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.67 | 19.82 | 20.07 | 20.4 | 20.71 | 20.91 | 20.98 | 20.97 | 20.82 | 20.43 | 20 | 19.65 | (87) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.92 | 19.92 | 19.93 | 19.94 | 19.94 | 19.96 | 19.96 | 19.96 | 19.95 | 19.94 | 19.94 | 19.93 | (88) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.96 | 0.88 | 0.69 | 0.48 | 0.54 | 0.82 | 0.97 | 1 | 1 | (89) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.71 | 18.86 | 19.11 | 19.45 | 19.74 | 19.91 | 19.95 | 19.95 | 19.85 | 19.49 | 19.05 | 18.7 | (90) |

fLA = Living area ÷ (4) = 0.26 (91)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.96 | 19.11 | 19.36 | 19.7 | 19.99 | 20.17 | 20.21 | 20.21 | 20.1 | 19.73 | 19.29 | 18.95 | (92) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.96 | 19.11 | 19.36 | 19.7 | 19.99 | 20.17 | 20.21 | 20.21 | 20.1 | 19.73 | 19.29 | 18.95 | (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

Utilisation factor for gains, hm:

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (94)m= | 1 | 0.99 | 0.99 | 0.96 | 0.88 | 0.71 | 0.52 | 0.57 | 0.84 | 0.97 | 0.99 | 1 | (94) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 349.47 | 399.05 | 439.34 | 467.3 | 453.1 | 358.36 | 247.98 | 257.92 | 350.38 | 365.59 | 340.01 | 330.92 | (95) |

Monthly average external temperature from Table 8

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (97)m= | 1064.71 | 1028.78 | 927.97 | 767.72 | 587.67 | 389.9 | 252.97 | 266.06 | 422.03 | 647.32 | 869.51 | 1057.82 | (97) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 532.14 | 423.18 | 363.54 | 216.31 | 100.13 | 0 | 0 | 0 | 0 | 209.61 | 381.24 | 540.81 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2766.95 (98)

Space heating requirement in kWh/m²/year 45.7 (99)

## 8c. Space cooling requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10) | | | | | | | | | | | | | |
| (100)m= | 0 | 0 | 0 | 0 | 0 | 657.87 | 517.9 | 530.6 | 0 | 0 | 0 | 0 | (100) |
| Utilisation factor for loss hm | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.84 | 0.91 | 0.88 | 0 | 0 | 0 | 0 | (101) |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 549.68 | 468.74 | 467.37 | 0 | 0 | 0 | 0 | (102) |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 661.18 | 633.4 | 600.61 | 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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (104)m= | 0 | 0 | 0 | 0 | 0 | 80.28 | 122.5 | 99.13 | 0 | 0 | 0 | 0 | |

Total = Sum(104)$_{5,8}$ = 301.91 (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)*$_{5,8}$ = 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 | 20.07 | 30.63 | 24.78 | 0 | 0 | 0 | 0 | |

Total = Sum(107)$_{5,8}$ = 75.48 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.25 (108)

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

Fabric Energy Efficiency (99) + (108) = 46.95 (109)

**Target Fabric Energy Efficiency (TFEE)** 53.99 (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 75

**Address :** Plot 75, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 30.27 (1a) | x | 2.4 (2a) | = | 72.65 | (3a) |
| Ground floor | 30.27 (1b) | x | 2.61 (2b) | = | 79 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 60.54 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 151.65 | (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 | | | | | | | 2 | x 10 = | 20 | (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) = | 20 | ÷ (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 | | | 3.78 | x | 1/[1/( 1.43 )+ 0.04] | = | 5.11 | | | (27) |
| Windows Type 3 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 4 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Floor | | | 30.27 | x | 0.12 | = | 3.6324 | | | (28) |
| Walls | 78 | 10.4 | 67.6 | x | 0.22 | = | 14.87 | | | (29) |
| Roof | 30.27 | 0 | 30.27 | x | 0.09 | = | 2.72 | | | (30) |
| Total area of elements, m² | | | 138.54 | | | | | | | (31) |
| Party wall | | | 40.41 | x | 0 | = | 0 | | | (32) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.55 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 8417.13 (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 12.01 (36)

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

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

Total fabric heat loss (33) + (36) = 46.56 (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= | 30.95 | 30.72 | 30.5 | 29.44 | 29.24 | 28.32 | 28.32 | 28.14 | 28.67 | 29.24 | 29.64 | 30.06 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 77.51 | 77.28 | 77.06 | 76 | 75.8 | 74.87 | 74.87 | 74.7 | 75.23 | 75.8 | 76.2 | 76.62 | |

Average = Sum(39)$_{1...12}$ /12= 75.99 (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 (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 81.63 (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= | 89.79 | 86.52 | 83.26 | 79.99 | 76.73 | 73.46 | 73.46 | 76.73 | 79.99 | 83.26 | 86.52 | 89.79 | |

Total = Sum(44)$_{1...12}$ = 979.51 (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= | 133.15 | 116.46 | 120.17 | 104.77 | 100.53 | 86.75 | 80.39 | 92.24 | 93.35 | 108.78 | 118.75 | 128.95 | |

Total = Sum(45)$_{1...12}$ = 1284.29 (45)

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

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

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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)

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

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= | 113.18 | 98.99 | 102.15 | 89.05 | 85.45 | 73.74 | 68.33 | 78.41 | 79.34 | 92.47 | 100.93 | 109.61 | (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= | 113.18 | 98.99 | 102.15 | 89.05 | 85.45 | 73.74 | 68.33 | 78.41 | 79.34 | 92.47 | 100.93 | 109.61 | |

Output from water heater (annual)$_{1...12}$ | 1091.64 | (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= | 28.3 | 24.75 | 25.54 | 22.26 | 21.36 | 18.43 | 17.08 | 19.6 | 19.84 | 23.12 | 25.23 | 27.4 | (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= | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 16 | 14.21 | 11.56 | 8.75 | 6.54 | 5.52 | 5.97 | 7.75 | 10.41 | 13.21 | 15.42 | 16.44 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 174.31 | 176.12 | 171.56 | 161.85 | 149.61 | 138.09 | 130.4 | 128.59 | 133.15 | 142.85 | 155.1 | 166.62 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | (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= | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 38.03 | 36.83 | 34.32 | 30.92 | 28.71 | 25.6 | 22.96 | 26.35 | 27.55 | 31.07 | 35.05 | 36.83 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 281.29 | 280.1 | 270.39 | 254.48 | 237.81 | 222.17 | 212.28 | 215.65 | 224.06 | 240.09 | 258.53 | 272.84 | (73) |

## 6. Solar gains:

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

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 3.78 | x | 36.79 | x | 0.63 | x | 0.7 | = | 42.5 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 62.67 | x | 0.63 | x | 0.7 | = | 72.4 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 85.75 | x | 0.63 | x | 0.7 | = | 99.06 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 106.25 | x | 0.63 | x | 0.7 | = | 122.74 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 119.01 | x | 0.63 | x | 0.7 | = | 137.48 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 118.15 | x | 0.63 | x | 0.7 | = | 136.49 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 113.91 | x | 0.63 | x | 0.7 | = | 131.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 104.39 | x | 0.63 | x | 0.7 | = | 120.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 92.85 | x | 0.63 | x | 0.7 | = | 107.26 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 69.27 | x | 0.63 | x | 0.7 | = | 80.02 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 44.07 | x | 0.63 | x | 0.7 | = | 50.91 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 31.49 | x | 0.63 | x | 0.7 | = | 36.38 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Northwest 0.9x | 0.77 | x | 1.62 | x | 11.28 | x | 0.63 | x | 0.7 | = | 5.59 | (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 | 1.62 | x | 22.97 | x | 0.63 | x | 0.7 | = | 11.37 | (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 | 1.62 | x | 41.38 | x | 0.63 | x | 0.7 | = | 20.49 | (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 | 1.62 | x | 67.96 | x | 0.63 | x | 0.7 | = | 33.64 | (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 | 1.62 | x | 91.35 | x | 0.63 | x | 0.7 | = | 45.22 | (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 | 1.62 | x | 97.38 | x | 0.63 | x | 0.7 | = | 48.21 | (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 | 1.62 | x | 91.1 | x | 0.63 | x | 0.7 | = | 45.1 | (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 | 1.62 | x | 72.63 | x | 0.63 | x | 0.7 | = | 35.96 | (81) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 1.62 | x | 50.42 | x | 0.63 | x | 0.7 | = | 24.96 | (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 | 1.62 | x | 28.07 | x | 0.63 | x | 0.7 | = | 13.9 | (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 | 1.62 | x | 14.2 | x | 0.63 | x | 0.7 | = | 7.03 | (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 | 1.62 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.56 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 69.25 | 121.46 | 175.5 | 233.05 | 275.28 | 279.56 | 266.91 | 234.45 | 195.28 | 136.75 | 83.58 | 58.85 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 350.54 | 401.56 | 445.89 | 487.53 | 513.09 | 501.73 | 479.19 | 450.1 | 419.34 | 376.84 | 342.11 | 331.69 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.98 | 0.93 | 0.81 | 0.65 | 0.7 | 0.9 | 0.98 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.57 | 19.72 | 19.98 | 20.32 | 20.65 | 20.89 | 20.97 | 20.96 | 20.78 | 20.36 | 19.91 | 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 | 1 | 0.99 | 0.96 | 0.89 | 0.72 | 0.5 | 0.56 | 0.84 | 0.97 | 1 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.56 | 18.71 | 18.97 | 19.32 | 19.63 | 19.83 | 19.88 | 19.88 | 19.76 | 19.37 | 18.91 | 18.55 | (90) |

fLA = Living area ÷ (4) = 0.26 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.82 | 18.97 | 19.23 | 19.58 | 19.89 | 20.1 | 20.16 | 20.16 | 20.02 | 19.62 | 19.17 | 18.8 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.82 | 18.97 | 19.23 | 19.58 | 19.89 | 20.1 | 20.16 | 20.16 | 20.02 | 19.62 | 19.17 | 18.8 | (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 | 0.99 | 0.96 | 0.89 | 0.74 | 0.54 | 0.6 | 0.85 | 0.97 | 0.99 | 1 | (94) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 349.43 | 399.03 | 439.52 | 468.64 | 458.25 | 369.39 | 259.1 | 268.63 | 356.19 | 366.2 | 340 | 330.88 | (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= | 1125.35 | 1087.44 | 980.7 | 811.61 | 621.05 | 412.17 | 266.7 | 280.61 | 445.57 | 683.91 | 919.47 | 1118.94 | (97) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 577.29 | 462.61 | 402.64 | 246.94 | 121.13 | 0 | 0 | 0 | 0 | 236.38 | 417.22 | 586.32 |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3050.52 (98)

Space heating requirement in kWh/m²/year 50.39 (99)

## 8c. Space cooling requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10) | | | | | | | | | | | | |
| (100)m= | 0 | 0 | 0 | 0 | 0 | 703.81 | 554.07 | 567.74 | 0 | 0 | 0 | 0 |
| Utilisation factor for loss hm | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.8 | 0.88 | 0.85 | 0 | 0 | 0 | 0 |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 562.43 | 485.48 | 481.76 | 0 | 0 | 0 | 0 |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 661.18 | 633.4 | 600.61 | 0 | 0 | 0 | 0 |

*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 | 71.1 | 110.05 | 88.43 | 0 | 0 | 0 | 0 |

Total = Sum(104)$_{5...8}$ = 269.58 (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)*$_{5...8}$ = 0 (106)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (107)m= | 0 | 0 | 0 | 0 | 0 | 17.78 | 27.51 | 22.11 | 0 | 0 | 0 | 0 |

Total = Sum(107)$_{5...8}$ = 67.4 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.11 (108)

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

Fabric Energy Efficiency (99) + (108) = 51.5 (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 75

**Address :** Plot 75, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 30.27 (1a) | x | 2.4 (2a) | = | 72.65 | (3a) |
| Ground floor | 30.27 (1b) | x | 2.61 (2b) | = | 79 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 60.54 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 151.65 | (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) = | 0.2 (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) | | 0.45 (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) = | | 0.45 (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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.57 | 0.56 | 0.55 | 0.49 | 0.48 | 0.43 | 0.43 | 0.41 | 0.45 | 0.48 | 0.5 | 0.53 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

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

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

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

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

(24a)

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

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

(24b)

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

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

(24c)

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

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

(24d)

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

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

(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 | | | 3.78 | x | 1/[1/( 1.43 )+ 0.04] | = | 5.11 | | | (27) |
| Windows Type 3 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Windows Type 4 | | | 1.44 | x | 1/[1/( 1.43 )+ 0.04] | = | 1.95 | | | (27) |
| Floor | | | 30.27 | x | 0.12 | = | 3.6324 | | | (28) |
| Walls | 78 | 10.4 | 67.6 | x | 0.22 | = | 14.87 | | | (29) |
| Roof | 30.27 | 0 | 30.27 | x | 0.09 | = | 2.72 | | | (30) |
| Total area of elements, m² | | | 138.54 | | | | | | | (31) |
| Party wall | | | 40.41 | x | 0 | = | 0 | | | (32) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.55 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 8417.13 (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 12.01 (36)

# DER WorkSheet: New dwelling design stage

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

Total fabric heat loss (33) + (36) = 46.56 (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= | 33.18 | 32.86 | 32.55 | 31.09 | 30.82 | 29.55 | 29.55 | 29.32 | 30.04 | 30.82 | 31.37 | 31.95 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 79.74 | 79.42 | 79.11 | 77.65 | 77.38 | 76.11 | 76.11 | 75.87 | 76.6 | 77.38 | 77.93 | 78.51 | |

Average = Sum(39)$_{1...12}$ /12= 77.65 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.32 | 1.31 | 1.31 | 1.28 | 1.28 | 1.26 | 1.26 | 1.25 | 1.27 | 1.28 | 1.29 | 1.3 | |

Average = Sum(40)$_{1...12}$ /12= 1.28 (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 (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 81.63 (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= | 89.79 | 86.52 | 83.26 | 79.99 | 76.73 | 73.46 | 73.46 | 76.73 | 79.99 | 83.26 | 86.52 | 89.79 | |

Total = Sum(44)$_{1...12}$ = 979.51 (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= | 133.15 | 116.46 | 120.17 | 104.77 | 100.53 | 86.75 | 80.39 | 92.24 | 93.35 | 108.78 | 118.75 | 128.95 | |

Total = Sum(45)$_{1...12}$ = 1284.29 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 19.97 | 17.47 | 18.03 | 15.72 | 15.08 | 13.01 | 12.06 | 13.84 | 14 | 16.32 | 17.81 | 19.34 | (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)

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)

# DER WorkSheet: New dwelling design stage

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= | 34.17 | 30.85 | 34.15 | 33.04 | 34.13 | 33.02 | 34.12 | 34.13 | 33.03 | 34.14 | 33.05 | 34.16 | (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= | 167.32 | 147.31 | 154.32 | 137.81 | 134.66 | 119.77 | 114.5 | 126.37 | 126.38 | 142.93 | 151.8 | 163.11 | (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= | 167.32 | 147.31 | 154.32 | 137.81 | 134.66 | 119.77 | 114.5 | 126.37 | 126.38 | 142.93 | 151.8 | 163.11 | |

Output from water heater (annual)$_{1...12}$ | 1686.28 | (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= | 52.81 | 46.44 | 48.49 | 43.1 | 41.96 | 37.1 | 35.26 | 39.2 | 39.29 | 44.71 | 47.75 | 51.42 | (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= | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 16 | 14.21 | 11.56 | 8.75 | 6.54 | 5.52 | 5.97 | 7.75 | 10.41 | 13.21 | 15.42 | 16.44 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 174.31 | 176.12 | 171.56 | 161.85 | 149.61 | 138.09 | 130.4 | 128.59 | 133.15 | 142.85 | 155.1 | 166.62 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | (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= | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 70.99 | 69.1 | 65.18 | 59.85 | 56.4 | 51.53 | 47.39 | 52.69 | 54.58 | 60.09 | 66.31 | 69.11 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 317.24 | 315.38 | 304.25 | 286.41 | 268.49 | 251.09 | 239.71 | 244.99 | 254.09 | 272.11 | 292.79 | 308.12 | (73) |

## 6. Solar gains:

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

# DER WorkSheet: New dwelling design stage

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 3.78 | x | 36.79 | x | 0.63 | x | 0.7 | = | 42.5 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 62.67 | x | 0.63 | x | 0.7 | = | 72.4 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 85.75 | x | 0.63 | x | 0.7 | = | 99.06 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 106.25 | x | 0.63 | x | 0.7 | = | 122.74 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 119.01 | x | 0.63 | x | 0.7 | = | 137.48 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 118.15 | x | 0.63 | x | 0.7 | = | 136.49 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 113.91 | x | 0.63 | x | 0.7 | = | 131.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 104.39 | x | 0.63 | x | 0.7 | = | 120.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 92.85 | x | 0.63 | x | 0.7 | = | 107.26 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 69.27 | x | 0.63 | x | 0.7 | = | 80.02 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 44.07 | x | 0.63 | x | 0.7 | = | 50.91 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 31.49 | x | 0.63 | x | 0.7 | = | 36.38 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Northwest 0.9x | 0.77 | x | 1.62 | x | 11.28 | x | 0.63 | x | 0.7 | = | 5.59 | (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 | 1.62 | x | 22.97 | x | 0.63 | x | 0.7 | = | 11.37 | (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 | 1.62 | x | 41.38 | x | 0.63 | x | 0.7 | = | 20.49 | (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 | 1.62 | x | 67.96 | x | 0.63 | x | 0.7 | = | 33.64 | (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 | 1.62 | x | 91.35 | x | 0.63 | x | 0.7 | = | 45.22 | (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 | 1.62 | x | 97.38 | x | 0.63 | x | 0.7 | = | 48.21 | (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 | 1.62 | x | 91.1 | x | 0.63 | x | 0.7 | = | 45.1 | (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 | 1.62 | x | 72.63 | x | 0.63 | x | 0.7 | = | 35.96 | (81) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 1.62 | x | 50.42 | x | 0.63 | x | 0.7 | = | 24.96 | (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 | 1.62 | x | 28.07 | x | 0.63 | x | 0.7 | = | 13.9 | (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 | 1.62 | x | 14.2 | x | 0.63 | x | 0.7 | = | 7.03 | (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 | 1.62 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.56 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 69.25 | 121.46 | 175.5 | 233.05 | 275.28 | 279.56 | 266.91 | 234.45 | 195.28 | 136.75 | 83.58 | 58.85 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 386.49 | 436.84 | 479.74 | 519.46 | 543.78 | 530.65 | 506.62 | 479.44 | 449.37 | 408.86 | 376.38 | 366.97 | (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 | 0.97 | 0.92 | 0.79 | 0.63 | 0.67 | 0.88 | 0.98 | 0.99 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.58 | 19.73 | 19.99 | 20.34 | 20.66 | 20.89 | 20.97 | 20.96 | 20.8 | 20.39 | 19.93 | 19.56 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.83 | 19.83 | 19.84 | 19.85 | 19.86 | 19.87 | 19.87 | 19.88 | 19.87 | 19.86 | 19.85 | 19.84 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.96 | 0.88 | 0.69 | 0.48 | 0.53 | 0.82 | 0.97 | 0.99 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.95 | 18.17 | 18.55 | 19.07 | 19.52 | 19.8 | 19.86 | 19.86 | 19.7 | 19.14 | 18.48 | 17.94 | (90) |

fLA = Living area ÷ (4) = 0.26 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.36 | 18.57 | 18.92 | 19.4 | 19.81 | 20.08 | 20.15 | 20.14 | 19.98 | 19.46 | 18.85 | 18.35 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.21 | 18.42 | 18.77 | 19.25 | 19.66 | 19.93 | 20 | 19.99 | 19.83 | 19.31 | 18.7 | 18.2 | (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 | 0.98 | 0.95 | 0.87 | 0.7 | 0.5 | 0.55 | 0.81 | 0.96 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 384.33 | 432.4 | 469.66 | 492.53 | 472.69 | 371.02 | 253.12 | 264 | 365.65 | 391.9 | 372.43 | 365.34 | (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= | 1109.55 | 1073.89 | 970.5 | 803.43 | 616 | 405.76 | 258.68 | 272.66 | 439.17 | 674.26 | 903.93 | 1099.34 | (97) |

# DER WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 539.56 | 431.08 | 372.62 | 223.84 | 106.62 | 0 | 0 | 0 | 0 | 210.07 | 382.68 | 546.09 |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2812.58 (98)

Space heating requirement in kWh/m²/year 46.46 (99)

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

**Space heating:**

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

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

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

Efficiency of main space heating system 1 90.2 (206)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 539.56 | 431.08 | 372.62 | 223.84 | 106.62 | 0 | 0 | 0 | 0 | 210.07 | 382.68 | 546.09 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 598.18 | 477.92 | 413.11 | 248.16 | 118.2 | 0 | 0 | 0 | 0 | 232.89 | 424.26 | 605.42 | (211) |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3118.16 (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)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 167.32 | 147.31 | 154.32 | 137.81 | 134.66 | 119.77 | 114.5 | 126.37 | 126.38 | 142.93 | 151.8 | 163.11 |

Efficiency of water heater 87 (216)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 89.42 | 89.36 | 89.24 | 88.95 | 88.39 | 87 | 87 | 87 | 87 | 88.88 | 89.27 | 89.44 |

(217)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 187.11 | 164.84 | 172.93 | 154.92 | 152.36 | 137.67 | 131.61 | 145.25 | 145.26 | 160.82 | 170.05 | 182.37 |

Total = Sum(219a)$_{1...12}$ = 1905.19 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 3118.16 |
| Water heating fuel used | | 1905.19 |
| 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 | | 282.51 (232) |
| Electricity generated by PVs | | -803.2 (233) |

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

# DER WorkSheet: New dwelling design stage

| | **Energy** kWh/year | | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) | x | 0.216 | = | 673.52 | (261) |
| Space heating (secondary) | (215) | x | 0.519 | = | 0 | (263) |
| Water heating | (219) | x | 0.216 | = | 411.52 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 1085.04 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) | x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) | x | 0.519 | = | 146.62 | (268) |
| Energy saving/generation technologies<br>Item 1 | | | 0.519 | = | -416.86 | (269) |
| Total CO2, kg/year | | sum of (265)…(271) = | | | 853.73 | (272) |
| **Dwelling CO2 Emission Rate** | | (272) ÷ (4) = | | | 14.1 | (273) |
| EI rating (section 14) | | | | | 89 | (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 75

**Address :** Plot 75, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 30.27 (1a) | x | 2.4 (2a) | = | 72.65 | (3a) |
| Ground floor | 30.27 (1b) | x | 2.61 (2b) | = | 79 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 60.54 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 151.65 | (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 | | | | | | | 2 | x 10 = | 20 | (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) = | 20 | ÷ (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 | | | 3.78 | x1/[1/( 1.4 )+ 0.04] | | = | 5.01 | | | (27) |
| Windows Type 3 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 4 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Floor | | | 30.27 | x | 0.13 | = | 3.9351 | | | (28) |
| Walls | 78 | 10.4 | 67.6 | x | 0.18 | = | 12.17 | | | (29) |
| Roof | 30.27 | 0 | 30.27 | x | 0.13 | = | 3.94 | | | (30) |
| Total area of elements, m² | | | 138.54 | | | | | | | (31) |
| Party wall | | | 40.41 | x | 0 | = | 0 | | | (32) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.56 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 8417.13 (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 8.11 (36)

# TER WorkSheet: New dwelling design stage

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

Total fabric heat loss (33) + (36) = 41.67 (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= | 30.95 | 30.72 | 30.5 | 29.44 | 29.24 | 28.32 | 28.32 | 28.14 | 28.67 | 29.24 | 29.64 | 30.06 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 72.62 | 72.39 | 72.17 | 71.11 | 70.91 | 69.99 | 69.99 | 69.82 | 70.34 | 70.91 | 71.31 | 71.73 | |

Average = Sum(39)$_{1...12}$ /12= 71.11 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.2 | 1.2 | 1.19 | 1.17 | 1.17 | 1.16 | 1.16 | 1.15 | 1.16 | 1.17 | 1.18 | 1.18 | |

Average = Sum(40)$_{1...12}$ /12= 1.17 (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 (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 81.63 (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= | 89.79 | 86.52 | 83.26 | 79.99 | 76.73 | 73.46 | 73.46 | 76.73 | 79.99 | 83.26 | 86.52 | 89.79 | |

Total = Sum(44)$_{1...12}$ = 979.51 (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= | 133.15 | 116.46 | 120.17 | 104.77 | 100.53 | 86.75 | 80.39 | 92.24 | 93.35 | 108.78 | 118.75 | 128.95 | |

Total = Sum(45)$_{1...12}$ = 1284.29 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 19.97 | 17.47 | 18.03 | 15.72 | 15.08 | 13.01 | 12.06 | 13.84 | 14 | 16.32 | 17.81 | 19.34 | (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)

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)

# TER WorkSheet: New dwelling design stage

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= | 45.75 | 39.82 | 42.43 | 39.45 | 39.1 | 36.23 | 37.44 | 39.1 | 39.45 | 42.43 | 42.67 | 45.75 | (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= | 178.91 | 156.28 | 162.6 | 144.22 | 139.63 | 122.98 | 117.82 | 131.34 | 132.79 | 151.21 | 161.42 | 174.71 | (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= | 178.91 | 156.28 | 162.6 | 144.22 | 139.63 | 122.98 | 117.82 | 131.34 | 132.79 | 151.21 | 161.42 | 174.71 | |

Output from water heater (annual)$_{1...12}$ | 1773.9 | (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= | 55.71 | 48.68 | 50.56 | 44.7 | 43.2 | 37.9 | 36.09 | 40.45 | 40.9 | 46.78 | 50.15 | 54.32 | (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= | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | 99.84 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 16 | 14.21 | 11.56 | 8.75 | 6.54 | 5.52 | 5.97 | 7.75 | 10.41 | 13.21 | 15.42 | 16.44 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 174.31 | 176.12 | 171.56 | 161.85 | 149.61 | 138.09 | 130.4 | 128.59 | 133.15 | 142.85 | 155.1 | 166.62 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | 32.98 | (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= | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | -79.87 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 74.88 | 72.44 | 67.96 | 62.08 | 58.07 | 52.64 | 48.5 | 54.36 | 56.8 | 62.87 | 69.65 | 73 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 321.14 | 318.71 | 307.03 | 288.64 | 270.16 | 252.21 | 240.82 | 246.66 | 256.32 | 274.9 | 296.13 | 312.01 | (73) |

## 6. Solar gains:

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

# TER WorkSheet: New dwelling design stage

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 3.78 | x | 36.79 | x | 0.63 | x | 0.7 | = | 42.5 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 62.67 | x | 0.63 | x | 0.7 | = | 72.4 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 85.75 | x | 0.63 | x | 0.7 | = | 99.06 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 106.25 | x | 0.63 | x | 0.7 | = | 122.74 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 119.01 | x | 0.63 | x | 0.7 | = | 137.48 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 118.15 | x | 0.63 | x | 0.7 | = | 136.49 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 113.91 | x | 0.63 | x | 0.7 | = | 131.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 104.39 | x | 0.63 | x | 0.7 | = | 120.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 92.85 | x | 0.63 | x | 0.7 | = | 107.26 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 69.27 | x | 0.63 | x | 0.7 | = | 80.02 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 44.07 | x | 0.63 | x | 0.7 | = | 50.91 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 31.49 | x | 0.63 | x | 0.7 | = | 36.38 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Northwest 0.9x | 0.77 | x | 1.62 | x | 11.28 | x | 0.63 | x | 0.7 | = | 5.59 | (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 | 1.62 | x | 22.97 | x | 0.63 | x | 0.7 | = | 11.37 | (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 | 1.62 | x | 41.38 | x | 0.63 | x | 0.7 | = | 20.49 | (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 | 1.62 | x | 67.96 | x | 0.63 | x | 0.7 | = | 33.64 | (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 | 1.62 | x | 91.35 | x | 0.63 | x | 0.7 | = | 45.22 | (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 | 1.62 | x | 97.38 | x | 0.63 | x | 0.7 | = | 48.21 | (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 | 1.62 | x | 91.1 | x | 0.63 | x | 0.7 | = | 45.1 | (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 | 1.62 | x | 72.63 | x | 0.63 | x | 0.7 | = | 35.96 | (81) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 1.62 | x | 50.42 | x | 0.63 | x | 0.7 | = | 24.96 | (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 | 1.62 | x | 28.07 | x | 0.63 | x | 0.7 | = | 13.9 | (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 | 1.62 | x | 14.2 | x | 0.63 | x | 0.7 | = | 7.03 | (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 | 1.62 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.56 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 69.25 | 121.46 | 175.5 | 233.05 | 275.28 | 279.56 | 266.91 | 234.45 | 195.28 | 136.75 | 83.58 | 58.85 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 390.39 | 440.18 | 482.53 | 521.69 | 545.44 | 531.76 | 507.74 | 481.12 | 451.59 | 411.65 | 379.72 | 370.86 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.99 | 0.96 | 0.9 | 0.75 | 0.59 | 0.64 | 0.86 | 0.97 | 0.99 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.73 | 19.88 | 20.12 | 20.45 | 20.74 | 20.93 | 20.98 | 20.98 | 20.85 | 20.48 | 20.05 | 19.71 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.92 | 19.92 | 19.93 | 19.94 | 19.94 | 19.96 | 19.96 | 19.96 | 19.95 | 19.94 | 19.94 | 19.93 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.95 | 0.86 | 0.66 | 0.46 | 0.51 | 0.79 | 0.96 | 0.99 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.24 | 18.46 | 18.81 | 19.29 | 19.68 | 19.91 | 19.95 | 19.95 | 19.83 | 19.34 | 18.72 | 18.22 | (90) |

fLA = Living area ÷ (4) = 0.26 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.62 | 18.82 | 19.15 | 19.59 | 19.95 | 20.17 | 20.21 | 20.21 | 20.09 | 19.63 | 19.06 | 18.6 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.62 | 18.82 | 19.15 | 19.59 | 19.95 | 20.17 | 20.21 | 20.21 | 20.09 | 19.63 | 19.06 | 18.6 | (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 | 0.98 | 0.95 | 0.86 | 0.68 | 0.49 | 0.54 | 0.8 | 0.96 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 388.3 | 435.76 | 472.17 | 493.13 | 469.01 | 363.7 | 249.05 | 259.83 | 362.56 | 393.9 | 375.79 | 369.3 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1040.35 | 1007.93 | 912.79 | 759.82 | 585.22 | 389.7 | 253 | 266.12 | 421.42 | 640.51 | 853.05 | 1033.13 | (97) |

# TER WorkSheet: New dwelling design stage

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 485.13 | 384.5 | 327.82 | 192.02 | 86.46 | 0 | 0 | 0 | 0 | 183.48 | 343.63 | 493.89 |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2496.91 (98)

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

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

**Space heating:**

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

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

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

Efficiency of main space heating system 1 93.4 (206)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | |
| | 485.13 | 384.5 | 327.82 | 192.02 | 86.46 | 0 | 0 | 0 | 0 | 183.48 | 343.63 | 493.89 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 519.41 | 411.67 | 350.98 | 205.59 | 92.57 | 0 | 0 | 0 | 0 | 196.44 | 367.91 | 528.79 | |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2673.36 (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)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 178.91 | 156.28 | 162.6 | 144.22 | 139.63 | 122.98 | 117.82 | 131.34 | 132.79 | 151.21 | 161.42 | 174.71 |

Efficiency of water heater 80.3 (216)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 87.44 | 87.23 | 86.78 | 85.77 | 83.88 | 80.3 | 80.3 | 80.3 | 80.3 | 85.54 | 86.91 | 87.52 |

(217)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 204.61 | 179.16 | 187.37 | 168.14 | 166.45 | 153.15 | 146.73 | 163.57 | 165.37 | 176.78 | 185.74 | 199.61 |

Total = Sum(219a)$_{1...12}$ = 2096.67 (219)

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 2673.36 | |
| Water heating fuel used | | 2096.67 | |
| 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 | | 282.51 | (232) |

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

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

# TER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 577.44 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 452.88 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1030.33 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 146.62 | (268) |
| Total CO2, kg/year | sum of (265)…(271) = | | | 1215.87 | (272) |

**TER =** 20.08 (273)

# SAP 2012 Overheating Assessment

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

## Property Details: Plot 75

| | |
|---|---|
| **Dwelling type:** | End-terrace House |
| **Located in:** | England |
| **Region:** | East Pennines |
| **Cross ventilation possible:** | Yes |
| **Number of storeys:** | 2 |
| **Front of dwelling faces:** | North 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:** | 150.14 | **(P1)** |
| **Transmission heat loss coefficient:** | 46.6 | |
| **Summer heat loss coefficient:** | 196.69 | **(P2)** |

## Overhangs:

| **Orientation:** | **Ratio:** | **Z_overhangs:** |
|---|---|---|
| North West (Living Room) | 0 | 1 |
| South East (Kitchen Doors) | 0 | 1 |
| South East (Bedroom 1) | 0 | 1 |
| North West (Bedroom 2) | 0 | 1 |

## Solar shading:

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

## Solar gains:

| **Orientation** | **Area** | **Flux** | **g_** | **FF** | **Shading** | **Gains** | |
|---|---|---|---|---|---|---|---|
| North West (Living Room) | 0.9 x 1.62 | 91.1 | 0.63 | 0.7 | 0.9 | 52.72 | |
| South East (Kitchen Doors) | 0.9 x 3.78 | 113.91 | 0.63 | 0.7 | 0.9 | 153.81 | |
| South East (Bedroom 1) | 0.9 x 1.44 | 113.91 | 0.63 | 0.7 | 0.9 | 58.59 | |
| North West (Bedroom 2) | 0.9 x 1.44 | 91.1 | 0.63 | 0.7 | 0.9 | 46.86 | |
| | | | | | **Total** | 311.98 | **(P3/P4)** |

## Internal gains:

| | **June** | **July** | **August** | |
|---|---|---|---|---|
| Internal gains | 360.35 | 345.85 | 352.92 | |
| Total summer gains | 687.11 | 657.83 | 626.96 | **(P5)** |
| Summer gain/loss ratio | 3.49 | 3.34 | 3.19 | **(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 | 18.34 | 20.19 | 19.84 | **(P7)** |
| **Likelihood of high internal temperature** | **Not significant** | **Not significant** | **Not significant** | |

# SAP 2012 Overheating Assessment

**Assessment of likelihood of high internal temperature:** Not significant