# Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.6
*Printed on Friday, March 3, 2017 at 2:20:23 PM*

## Project Information:

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

## Dwelling Details:

**NEW DWELLING DESIGN STAGE** Total Floor Area: 74.42m²
**Site Reference :** Wardentree Lane **Plot Reference:** Plot 76
**Address :** Plot 76, 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) | 20.39 kg/m² | |
| Dwelling Carbon Dioxide Emission Rate (DER) | 15.69 kg/m² | OK |

## 1b TFEE and DFEE

| | | |
|---|---|---|
| Target Fabric Energy Efficiency (TFEE) | 60.7 kWh/m² | |
| Dwelling Fabric Energy Efficiency (DFEE) | 59.2 kWh/m² | |
| | | OK |

## 2 Fabric U-values

| Element | Average | Highest | |
|---|---|---|---|
| External wall | 0.24 (max. 0.30) | 0.24 (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 | 1.20 (max. 2.00) | 1.20 (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 408, 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

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## 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 West | 1.1m² |
| Windows facing: North West | 1.44m² |
| Windows facing: North West | 1.1m² |
| Windows facing: South East | 1.44m² |
| Windows facing: South East | 0.66m² |
| Windows facing: South West | 0.66m² |
| Windows facing: South East | 3.78m² |
| Ventilation rate: | 3.00 |
| Blinds/curtains: | |
| | Closed 100% of daylight hours |

## 10 Key features

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

# SAP Input

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## Property Details: Plot 76

| | |
|---|---|
| Address: | Plot 76, Land off Wardentree Lane, Spalding |
| Located in: | England |
| Region: | East Pennines |
| UPRN: | |
| Date of assessment: | Tuesday, February 14, 2017 |
| Date of certificate: | Friday, March 3, 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: | 408 |

## Property description:

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

| Floor Location: | Floor area: | Storey height: |
|---|---|---|
| Basement floor | 37.21 m² | 2.4 m |
| Floor 1 | 37.21 m² | 2.61 m |

| | |
|---|---|
| Living area: | 19.87 m² (fraction 0.267) |
| 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 |
| W1 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W2 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W3 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W4 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W5 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W6 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W7 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| D2 | 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 | 2.12 | 1 |
| W1 | 16mm or more | 0.7 | 0.63 | 1.2 | 1.62 | 1 |
| W2 | 16mm or more | 0.7 | 0.63 | 1.2 | 1.1 | 1 |
| W3 | 16mm or more | 0.7 | 0.63 | 1.2 | 1.44 | 1 |
| W4 | 16mm or more | 0.7 | 0.63 | 1.2 | 1.1 | 1 |
| W5 | 16mm or more | 0.7 | 0.63 | 1.2 | 1.44 | 1 |
| W6 | 16mm or more | 0.7 | 0.63 | 1.2 | 0.66 | 1 |
| W7 | 16mm or more | 0.7 | 0.63 | 1.2 | 0.66 | 1 |
| D2 | 16mm or more | 0.7 | 0.63 | 1.2 | 3.78 | 1 |

| Name: | Type-Name: | Location: | Orient: | Width: | Height: |
|---|---|---|---|---|---|
| Front Door | | External Wall | North West | 1.01 | 2.1 |
| W1 | | External Wall | North West | 1.2 | 1.35 |
| W2 | | External Wall | South West | 0.915 | 1.2 |
| W3 | | External Wall | North West | 1.2 | 1.2 |
| W4 | | External Wall | North West | 0.915 | 1.2 |
| W5 | | External Wall | South East | 1.2 | 1.2 |
| W6 | | External Wall | South East | 0.63 | 1.05 |

# SAP Input

| | | | | |
|---|---|---|---|---|
| W7 | External Wall | South West | 0.63 | 1.05 |
| D2 | External Wall | South East | 1.8 | 2.1 |

Overshading: Average or unknown

## Opaque Elements:

| Type: | Gross area: | Openings: | Net area: | U-value: | Ru value: | Curtain wall: | Kappa: |
|---|---|---|---|---|---|---|---|
| External Elements | | | | | | | |
| External Wall | 126.95 | 13.92 | 113.03 | 0.24 | 0 | False | N/A |
| Main Roof | 37.21 | 0 | 37.21 | 0.09 | 0 | | N/A |
| Ground Floor | 37.21 | | | 0.12 | | | N/A |
| Internal Elements | | | | | | | |
| Party Elements | | | | | | | |
| Party Wall | 40.24 | | | | | | N/A |

## Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0797

| | Length | Psi-value | | |
|---|---|---|---|---|
| [Approved] | 9.5 | 0.5 | E1 | Steel lintel with perforated steel base plate |
| [Approved] | 6.69 | 0.04 | E3 | Sill |
| [Approved] | 24.3 | 0.05 | E4 | Jamb |
| [Approved] | 25.34 | 0.16 | E5 | Ground floor (normal) |
| [Approved] | 9.24 | 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] | 25.34 | 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 408, 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

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## Main heating Control:

| | |
|---|---|
| Main heating Control: | Time and temperature zone control by suitable arrangement of plumbing and electrical services<br>Control code: 2110 |

## Secondary heating system:

| | |
|---|---|
| Secondary heating system: | None |

## Water heating:

| | |
|---|---|
| Water heating: | From main heating system<br>Water code: 901<br>Fuel :mains gas<br>No hot water cylinder<br>Solar panel: False |

## Others:

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

# SAP WorkSheet: New dwelling design stage

STUDIO11 architecture

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Chloe Hewitt | **Stroma Number:** | STRO029693 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.6 |

## Property Address: Plot 76

**Address :** Plot 76, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 37.21 | (1a) x | 2.4 | (2a) = | 89.3 | (3a) |
| Ground floor | 37.21 | (1b) x | 2.61 | (2b) = | 97.12 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 74.42 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 186.42 | (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) = | 0.16 (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) | | 0.41 (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) = | | 0.41 (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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.52 | 0.51 | 0.5 | 0.45 | 0.44 | 0.39 | 0.39 | 0.38 | 0.41 | 0.44 | 0.46 | 0.48 |

*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= | 0.64 | 0.63 | 0.63 | 0.6 | 0.6 | 0.58 | 0.58 | 0.57 | 0.58 | 0.6 | 0.61 | 0.62 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.64 | 0.63 | 0.63 | 0.6 | 0.6 | 0.58 | 0.58 | 0.57 | 0.58 | 0.6 | 0.61 | 0.62 |

(25)

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2.12 | x | 1.2 | = | 2.544 | | | (26) |
| Windows Type 1 | | | 1.62 | x1/[1/( 1.2 )+ 0.04] | | = | 1.85 | | | (27) |
| Windows Type 2 | | | 1.1 | x1/[1/( 1.2 )+ 0.04] | | = | 1.26 | | | (27) |
| Windows Type 3 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 4 | | | 1.1 | x1/[1/( 1.2 )+ 0.04] | | = | 1.26 | | | (27) |
| Windows Type 5 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 6 | | | 0.66 | x1/[1/( 1.2 )+ 0.04] | | = | 0.76 | | | (27) |
| Windows Type 7 | | | 0.66 | x1/[1/( 1.2 )+ 0.04] | | = | 0.76 | | | (27) |
| Windows Type 8 | | | 3.78 | x1/[1/( 1.2 )+ 0.04] | | = | 4.33 | | | (27) |
| Floor | | | 37.21 | x | 0.12 | = | 4.4652 | | | (28) |
| Walls | 126.95 | 13.92 | 113.03 | x | 0.24 | = | 27.13 | | | (29) |
| Roof | 37.21 | 0 | 37.21 | x | 0.09 | = | 3.35 | | | (30) |
| Total area of elements, m² | | | 201.37 | | | | | | | (31) |
| Party wall | | | 40.24 | x | 0 | = | 0 | | | (32) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 51 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 11718.24 (34)

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

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*can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K — 16.05 (36)

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

Total fabric heat loss (33) + (36) = 67.05 (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= | 39.2 | 38.88 | 38.55 | 37.04 | 36.76 | 35.45 | 35.45 | 35.2 | 35.95 | 36.76 | 37.33 | 37.93 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 106.25 | 105.92 | 105.6 | 104.09 | 103.81 | 102.49 | 102.49 | 102.25 | 103 | 103.81 | 104.38 | 104.98 | |

Average = Sum(39)$_{1...12}$ /12= 104.09 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.43 | 1.42 | 1.42 | 1.4 | 1.39 | 1.38 | 1.38 | 1.37 | 1.38 | 1.39 | 1.4 | 1.41 | |

Average = Sum(40)$_{1...12}$ /12= 1.4 (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 — 2.35 (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 — 89.98 (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= | 98.97 | 95.38 | 91.78 | 88.18 | 84.58 | 80.98 | 80.98 | 84.58 | 88.18 | 91.78 | 95.38 | 98.97 | |

Total = Sum(44)$_{1...12}$ = 1079.72 (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= | 146.78 | 128.37 | 132.47 | 115.49 | 110.81 | 95.62 | 88.61 | 101.68 | 102.9 | 119.91 | 130.9 | 142.14 | |

Total = Sum(45)$_{1...12}$ = 1415.68 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 22.02 | 19.26 | 19.87 | 17.32 | 16.62 | 14.34 | 13.29 | 15.25 | 15.43 | 17.99 | 19.63 | 21.32 | (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)

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Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

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

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

(56)

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

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

(57)

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

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

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

(59)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 34.19 | 30.87 | 34.17 | 33.05 | 34.15 | 33.03 | 34.13 | 34.14 | 33.04 | 34.16 | 33.07 | 34.18 |

(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= | 180.96 | 159.24 | 166.63 | 148.54 | 144.96 | 128.66 | 122.74 | 135.82 | 135.94 | 154.07 | 163.97 | 176.33 |

(62)

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

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

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

(63)

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 180.96 | 159.24 | 166.63 | 148.54 | 144.96 | 128.66 | 122.74 | 135.82 | 135.94 | 154.07 | 163.97 | 176.33 |

Output from water heater (annual)$_{1...12}$ 1817.86 (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= | 57.35 | 50.4 | 52.59 | 46.66 | 45.38 | 40.05 | 37.99 | 42.34 | 42.47 | 48.41 | 51.79 | 55.81 |

(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= | 140.91 | 140.91 | 140.91 | 140.91 | 140.91 | 140.91 | 140.91 | 140.91 | 140.91 | 140.91 | 140.91 | 140.91 |

(66)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 46.94 | 41.69 | 33.9 | 25.67 | 19.19 | 16.2 | 17.5 | 22.75 | 30.53 | 38.77 | 45.25 | 48.24 |

(67)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 309.53 | 312.74 | 304.65 | 287.42 | 265.67 | 245.22 | 231.57 | 228.35 | 236.45 | 253.68 | 275.43 | 295.87 |

(68)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 51.44 | 51.44 | 51.44 | 51.44 | 51.44 | 51.44 | 51.44 | 51.44 | 51.44 | 51.44 | 51.44 | 51.44 |

(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= | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 |

(71)

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 77.08 | 75 | 70.68 | 64.81 | 61 | 55.63 | 51.07 | 56.91 | 58.99 | 65.07 | 71.93 | 75.01 |

(72)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 534.96 | 530.84 | 510.64 | 479.3 | 447.26 | 418.46 | 401.55 | 409.43 | 427.38 | 458.93 | 494.02 | 520.53 |

(73)

## 6. Solar gains:

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

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| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 36.79 | x | 0.63 | x | 0.7 | = | 7.42 | (77) |
| 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 | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 62.67 | x | 0.63 | x | 0.7 | = | 12.64 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 62.67 | x | 0.63 | x | 0.7 | = | 72.4 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 85.75 | x | 0.63 | x | 0.7 | = | 17.3 | (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 | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 106.25 | x | 0.63 | x | 0.7 | = | 21.43 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 106.25 | x | 0.63 | x | 0.7 | = | 122.74 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 119.01 | x | 0.63 | x | 0.7 | = | 24 | (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 | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 118.15 | x | 0.63 | x | 0.7 | = | 23.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 118.15 | x | 0.63 | x | 0.7 | = | 136.49 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 113.91 | x | 0.63 | x | 0.7 | = | 22.98 | (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 | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 104.39 | x | 0.63 | x | 0.7 | = | 21.06 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 104.39 | x | 0.63 | x | 0.7 | = | 120.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 92.85 | x | 0.63 | x | 0.7 | = | 18.73 | (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 | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 69.27 | x | 0.63 | x | 0.7 | = | 13.97 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 69.27 | x | 0.63 | x | 0.7 | = | 80.02 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 44.07 | x | 0.63 | x | 0.7 | = | 8.89 | (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 | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 31.49 | x | 0.63 | x | 0.7 | = | 6.35 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 31.49 | x | 0.63 | x | 0.7 | = | 36.38 | (77) |
| Southwest 0.9x | 0.77 | x | 1.1 | x | 36.79 | | 0.63 | x | 0.7 | = | 12.37 | (79) |
| Southwest 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest 0.9x | 0.77 | x | 1.1 | x | 62.67 | | 0.63 | x | 0.7 | = | 21.07 | (79) |

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 85.75 | | 0.63 | x | 0.7 | = | 28.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 106.25 | | 0.63 | x | 0.7 | = | 35.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 119.01 | | 0.63 | x | 0.7 | = | 40.01 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 118.15 | | 0.63 | x | 0.7 | = | 39.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 113.91 | | 0.63 | x | 0.7 | = | 38.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 104.39 | | 0.63 | x | 0.7 | = | 35.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 92.85 | | 0.63 | x | 0.7 | = | 31.21 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 69.27 | | 0.63 | x | 0.7 | = | 23.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 44.07 | | 0.63 | x | 0.7 | = | 14.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 31.49 | | 0.63 | x | 0.7 | = | 10.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | (79) |
| Northwest | 0.9x | 0.77 | x | 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 | 1.1 | x | 11.28 | x | 0.63 | x | 0.7 | = | 3.79 | (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 | 1.1 | x | 22.97 | x | 0.63 | x | 0.7 | = | 7.72 | (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 | 1.1 | x | 41.38 | x | 0.63 | x | 0.7 | = | 13.91 | (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 | 1.1 | x | 67.96 | x | 0.63 | x | 0.7 | = | 22.85 | (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 | 1.1 | x | 91.35 | x | 0.63 | x | 0.7 | = | 30.71 | (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 | 1.1 | x | 97.38 | x | 0.63 | x | 0.7 | = | 32.74 | (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) |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 91.1 | x | 0.63 | x | 0.7 | = | 30.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.62 | x | 72.63 | x | 0.63 | x | 0.7 | = | 35.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 72.63 | x | 0.63 | x | 0.7 | = | 24.42 | (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 | 1.1 | x | 50.42 | x | 0.63 | x | 0.7 | = | 16.95 | (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 | 1.1 | x | 28.07 | x | 0.63 | x | 0.7 | = | 9.44 | (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 | 1.1 | x | 14.2 | x | 0.63 | x | 0.7 | = | 4.77 | (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) |
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.1 | (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= | 100.25 | 175.53 | 252.83 | 334.48 | 394.01 | 399.68 | 381.79 | 336.07 | 280.9 | 197.41 | 120.95 | 85.23 | (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= | 635.21 | 706.38 | 763.47 | 813.78 | 841.27 | 818.14 | 783.33 | 745.5 | 708.28 | 656.34 | 614.97 | 605.77 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.99 | 0.99 | 0.97 | 0.94 | 0.86 | 0.71 | 0.55 | 0.6 | 0.81 | 0.95 | 0.99 | 0.99 | (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= | 19.63 | 19.79 | 20.05 | 20.4 | 20.71 | 20.91 | 20.98 | 20.97 | 20.84 | 20.45 | 19.98 | 19.6 | (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= | 19.74 | 19.75 | 19.75 | 19.76 | 19.77 | 19.78 | 19.78 | 19.78 | 19.78 | 19.77 | 19.76 | 19.76 | (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= | 0.99 | 0.98 | 0.96 | 0.92 | 0.81 | 0.61 | 0.41 | 0.46 | 0.73 | 0.93 | 0.98 | 0.99 | (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= | 17.96 | 18.2 | 18.58 | 19.09 | 19.49 | 19.73 | 19.77 | 19.77 | 19.65 | 19.16 | 18.49 | 17.93 | (90) |

fLA = Living area ÷ (4) = 0.27 (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= | 18.41 | 18.62 | 18.97 | 19.44 | 19.82 | 20.04 | 20.1 | 20.09 | 19.97 | 19.5 | 18.89 | 18.38 | (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= | 18.26 | 18.47 | 18.82 | 19.29 | 19.67 | 19.89 | 19.95 | 19.94 | 19.82 | 19.35 | 18.74 | 18.23 | (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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

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Utilisation factor for gains, hm:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (94)m= | 0.98 | 0.97 | 0.95 | 0.91 | 0.81 | 0.62 | 0.43 | 0.47 | 0.73 | 0.92 | 0.97 | 0.99 | (94) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 625.14 | 688.44 | 728.89 | 737.84 | 677.23 | 508.21 | 337.53 | 354.01 | 518.04 | 602.01 | 598.27 | 597.75 | (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= | 1482.74 | 1437.57 | 1301.37 | 1081.22 | 827.05 | 542.44 | 342.84 | 362.11 | 589.1 | 908.83 | 1214.83 | 1472.64 | (97) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 638.06 | 503.41 | 425.93 | 247.23 | 111.47 | 0 | 0 | 0 | 0 | 228.27 | 443.92 | 650.92 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3249.21 (98)

Space heating requirement in kWh/m²/year 43.66 (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) | 638.06 | 503.41 | 425.93 | 247.23 | 111.47 | 0 | 0 | 0 | 0 | 228.27 | 443.92 | 650.92 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 707.38 | 558.11 | 472.21 | 274.09 | 123.58 | 0 | 0 | 0 | 0 | 253.07 | 492.16 | 721.64 | (211) |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3602.23 (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)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 180.96 | 159.24 | 166.63 | 148.54 | 144.96 | 128.66 | 122.74 | 135.82 | 135.94 | 154.07 | 163.97 | 176.33 | |

Efficiency of water heater 87 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 89.47 | 89.41 | 89.28 | 88.97 | 88.36 | 87 | 87 | 87 | 87 | 88.88 | 89.31 | 89.5 | (217) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 202.25 | 178.1 | 186.65 | 166.95 | 164.05 | 147.88 | 141.08 | 156.11 | 156.25 | 173.34 | 183.59 | 197.02 | |

Total = Sum(219a)$_{1...12}$ = 2053.28 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 3602.23 |
| Water heating fuel used | | 2053.28 |
| Electricity for pumps, fans and electric keep-hot | | |

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| | | | |
|---|---|---|---|
| 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 | | 331.56 | (232) |
| Electricity generated by PVs | | -803.2 | (233) |

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

| | | **Fuel** kWh/year | | **Fuel Price** (Table 12) | | **Fuel Cost** £/year | |
|---|---|---|---|---|---|---|---|
| Space heating - main system 1 | (211) | x | | 3.48 | x 0.01 = | 125.36 | (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 = | 71.45 | (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 = | 43.73 | (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) = | | | | | 264.5 | (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] = | 0.93 | (257) |
| **SAP rating (Section 12)** | 87.02 | (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 | = | 778.08 | (261) |
| Space heating (secondary) | (215) | x | | 0.519 | = | 0 | (263) |
| Water heating | (219) | x | | 0.216 | = | 443.51 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | | 1221.59 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) | x | | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) | x | | 0.519 | = | 172.08 | (268) |
| Energy saving/generation technologies Item 1 | | | | 0.519 | = | -416.86 | (269) |
| Total CO2, kg/year | sum of (265)…(271) = | | | | | 1015.74 | (272) |
| **CO2 emissions per m²** | (272) ÷ (4) = | | | | | 13.65 | (273) |

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| | | | | | |
|---|---|---|---|---|---|
| EI rating (section 14) | | | | 89 | (274) |

## 13a. Primary Energy

| | Energy kWh/year | | Primary factor | | P. Energy kWh/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) | x | 1.22 | = | 4394.72 | (261) |
| Space heating (secondary) | (215) | x | 3.07 | = | 0 | (263) |
| Energy for water heating | (219) | x | 1.22 | = | 2505 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 6899.73 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) | x | 3.07 | = | 230.25 | (267) |
| Electricity for lighting | (232) | x | 0 | = | 1017.88 | (268) |
| Energy saving/generation technologies Item 1 | | | 3.07 | = | -2465.81 | (269) |
| 'Total Primary Energy | | sum of (265)…(271) = | | | 5682.04 | (272) |
| **Primary energy kWh/m²/year** | | (272) ÷ (4) = | | | 76.35 | (273) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

STUDIO11 architecture

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Chloe Hewitt | **Stroma Number:** | STRO029693 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.6 |

## Property Address: Plot 76

**Address :** Plot 76, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 37.21 | (1a) x | 2.4 | (2a) = | 89.3 | (3a) |
| Ground floor | 37.21 | (1b) x | 2.61 | (2b) = | 97.12 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 74.42 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 186.42 | (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) = | 0.16 (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) | 0.41 (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) = | 0.41 (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 stag

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Wind Factor (22a)m = (22)m ÷ 4

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

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.52 | 0.51 | 0.5 | 0.45 | 0.44 | 0.39 | 0.39 | 0.38 | 0.41 | 0.44 | 0.46 | 0.48 |

*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= | 0.64 | 0.63 | 0.63 | 0.6 | 0.6 | 0.58 | 0.58 | 0.57 | 0.58 | 0.6 | 0.61 | 0.62 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.64 | 0.63 | 0.63 | 0.6 | 0.6 | 0.58 | 0.58 | 0.57 | 0.58 | 0.6 | 0.61 | 0.62 |

(25)

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2.12 | x | 1.2 | = | 2.544 | | | (26) |
| Windows Type 1 | | | 1.62 | x1/[1/( 1.4 )+ 0.04] | | = | 2.15 | | | (27) |
| Windows Type 2 | | | 1.1 | x1/[1/( 1.4 )+ 0.04] | | = | 1.46 | | | (27) |
| Windows Type 3 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 4 | | | 1.1 | x1/[1/( 1.4 )+ 0.04] | | = | 1.46 | | | (27) |
| Windows Type 5 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 6 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 7 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 8 | | | 3.78 | x1/[1/( 1.4 )+ 0.04] | | = | 5.01 | | | (27) |
| Floor | | | 37.21 | x | 0.13 | = | 4.8373 | | | (28) |
| Walls | 126.95 | 13.92 | 113.03 | x | 0.18 | = | 20.35 | | | (29) |
| Roof | 37.21 | 0 | 37.21 | x | 0.13 | = | 4.84 | | | (30) |
| Total area of elements, m² | | | 201.37 | | | | | | | (31) |
| Party wall | | | 40.24 | 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) = 48.21 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 11718.24 (34)

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

*can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K — 10.23 (36)

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

Total fabric heat loss (33) + (36) = 58.44 (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= | 39.2 | 38.88 | 38.55 | 37.04 | 36.76 | 35.45 | 35.45 | 35.2 | 35.95 | 36.76 | 37.33 | 37.93 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 97.64 | 97.31 | 96.99 | 95.48 | 95.2 | 93.88 | 93.88 | 93.64 | 94.39 | 95.2 | 95.77 | 96.37 | |

Average = Sum(39)$_{1...12}$ /12= 95.48 (39)

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

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

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 — 2.35 (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 — 89.98 (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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 98.97 | 95.38 | 91.78 | 88.18 | 84.58 | 80.98 | 80.98 | 84.58 | 88.18 | 91.78 | 95.38 | 98.97 | |

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

Total = Sum(44)$_{1...12}$ = 1079.72 (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= | 146.78 | 128.37 | 132.47 | 115.49 | 110.81 | 95.62 | 88.61 | 101.68 | 102.9 | 119.91 | 130.9 | 142.14 | |

Total = Sum(45)$_{1...12}$ = 1415.68 (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)

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Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

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

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

(56)

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

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

(57)

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

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

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

(59)

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

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

(61)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 124.76 | 109.12 | 112.6 | 98.17 | 94.19 | 81.28 | 75.32 | 86.43 | 87.46 | 101.93 | 111.26 | 120.82 |

(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= | 124.76 | 109.12 | 112.6 | 98.17 | 94.19 | 81.28 | 75.32 | 86.43 | 87.46 | 101.93 | 111.26 | 120.82 |

Output from water heater (annual)$_{1...12}$ 1203.33 (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= | 31.19 | 27.28 | 28.15 | 24.54 | 23.55 | 20.32 | 18.83 | 21.61 | 21.87 | 25.48 | 27.82 | 30.21 |

(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= | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 |

(66)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 18.77 | 16.68 | 13.56 | 10.27 | 7.67 | 6.48 | 7 | 9.1 | 12.21 | 15.51 | 18.1 | 19.3 |

(67)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 207.39 | 209.54 | 204.11 | 192.57 | 178 | 164.3 | 155.15 | 153 | 158.42 | 169.97 | 184.54 | 198.24 |

(68)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 |

(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= | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 |

(71)

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 41.92 | 40.59 | 37.84 | 34.09 | 31.65 | 28.22 | 25.31 | 29.04 | 30.37 | 34.25 | 38.63 | 40.6 |

(72)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 326.31 | 325.03 | 313.74 | 295.15 | 275.55 | 257.23 | 245.69 | 249.37 | 259.23 | 277.95 | 299.5 | 316.36 |

(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 stag

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| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 36.79 | x | 0.63 | x | 0.7 | = | 7.42 | (77) |
| 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 | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 62.67 | x | 0.63 | x | 0.7 | = | 12.64 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 62.67 | x | 0.63 | x | 0.7 | = | 72.4 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 85.75 | x | 0.63 | x | 0.7 | = | 17.3 | (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 | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 106.25 | x | 0.63 | x | 0.7 | = | 21.43 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 106.25 | x | 0.63 | x | 0.7 | = | 122.74 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 119.01 | x | 0.63 | x | 0.7 | = | 24 | (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 | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 118.15 | x | 0.63 | x | 0.7 | = | 23.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 118.15 | x | 0.63 | x | 0.7 | = | 136.49 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 113.91 | x | 0.63 | x | 0.7 | = | 22.98 | (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 | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 104.39 | x | 0.63 | x | 0.7 | = | 21.06 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 104.39 | x | 0.63 | x | 0.7 | = | 120.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 92.85 | x | 0.63 | x | 0.7 | = | 18.73 | (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 | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 69.27 | x | 0.63 | x | 0.7 | = | 13.97 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 69.27 | x | 0.63 | x | 0.7 | = | 80.02 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 44.07 | x | 0.63 | x | 0.7 | = | 8.89 | (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 | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 31.49 | x | 0.63 | x | 0.7 | = | 6.35 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 31.49 | x | 0.63 | x | 0.7 | = | 36.38 | (77) |
| Southwest 0.9x | 0.77 | x | 1.1 | x | 36.79 | | 0.63 | x | 0.7 | = | 12.37 | (79) |
| Southwest 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest 0.9x | 0.77 | x | 1.1 | x | 62.67 | | 0.63 | x | 0.7 | = | 21.07 | (79) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stag

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 85.75 | | 0.63 | x | 0.7 | = | 28.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 106.25 | | 0.63 | x | 0.7 | = | 35.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 119.01 | | 0.63 | x | 0.7 | = | 40.01 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 118.15 | | 0.63 | x | 0.7 | = | 39.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 113.91 | | 0.63 | x | 0.7 | = | 38.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 104.39 | | 0.63 | x | 0.7 | = | 35.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 92.85 | | 0.63 | x | 0.7 | = | 31.21 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 69.27 | | 0.63 | x | 0.7 | = | 23.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 44.07 | | 0.63 | x | 0.7 | = | 14.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 31.49 | | 0.63 | x | 0.7 | = | 10.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | (79) |
| Northwest | 0.9x | 0.77 | x | 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 | 1.1 | x | 11.28 | x | 0.63 | x | 0.7 | = | 3.79 | (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 | 1.1 | x | 22.97 | x | 0.63 | x | 0.7 | = | 7.72 | (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 | 1.1 | x | 41.38 | x | 0.63 | x | 0.7 | = | 13.91 | (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 | 1.1 | x | 67.96 | x | 0.63 | x | 0.7 | = | 22.85 | (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 | 1.1 | x | 91.35 | x | 0.63 | x | 0.7 | = | 30.71 | (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 | 1.1 | x | 97.38 | x | 0.63 | x | 0.7 | = | 32.74 | (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) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stag

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 91.1 | x | 0.63 | x | 0.7 | = | 30.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.62 | x | 72.63 | x | 0.63 | x | 0.7 | = | 35.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 72.63 | x | 0.63 | x | 0.7 | = | 24.42 | (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 | 1.1 | x | 50.42 | x | 0.63 | x | 0.7 | = | 16.95 | (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 | 1.1 | x | 28.07 | x | 0.63 | x | 0.7 | = | 9.44 | (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 | 1.1 | x | 14.2 | x | 0.63 | x | 0.7 | = | 4.77 | (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) |
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.1 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 100.25 | 175.53 | 252.83 | 334.48 | 394.01 | 399.68 | 381.79 | 336.07 | 280.9 | 197.41 | 120.95 | 85.23 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 426.56 | 500.57 | 566.57 | 629.63 | 669.56 | 656.9 | 627.47 | 585.44 | 540.13 | 475.37 | 420.45 | 401.59 | (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 | 0.79 | 0.62 | 0.68 | 0.89 | 0.98 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.52 | 19.69 | 19.96 | 20.33 | 20.66 | 20.89 | 20.97 | 20.96 | 20.79 | 20.35 | 19.88 | 19.5 | (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 | 19.87 | 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 | 0.99 | 0.96 | 0.88 | 0.69 | 0.48 | 0.54 | 0.83 | 0.97 | 1 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.49 | 18.66 | 18.94 | 19.31 | 19.62 | 19.82 | 19.86 | 19.86 | 19.74 | 19.34 | 18.86 | 18.48 | (90) |

fLA = Living area ÷ (4) = 0.27 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.77 | 18.94 | 19.21 | 19.58 | 19.9 | 20.11 | 20.16 | 20.15 | 20.02 | 19.61 | 19.13 | 18.76 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.77 | 18.94 | 19.21 | 19.58 | 19.9 | 20.11 | 20.16 | 20.15 | 20.02 | 19.61 | 19.13 | 18.76 | (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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

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Utilisation factor for gains, hm:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (94)m= | 1 | 0.99 | 0.98 | 0.96 | 0.88 | 0.71 | 0.52 | 0.58 | 0.84 | 0.97 | 0.99 | 1 | (94) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 425.25 | 497.23 | 557.56 | 601.67 | 588.46 | 468.6 | 325.75 | 337.93 | 452.06 | 460.98 | 417.85 | 400.65 | (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= | 1412.75 | 1365.98 | 1232.79 | 1019.94 | 780.78 | 517.07 | 334.23 | 351.61 | 559.14 | 857.88 | 1152.45 | 1402.73 | (97) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 734.7 | 583.8 | 502.37 | 301.16 | 143.08 | 0 | 0 | 0 | 0 | 295.29 | 528.91 | 745.54 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3834.87 (98)

Space heating requirement in kWh/m²/year 51.53 (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 | 882.51 | 694.75 | 711.67 | 0 | 0 | 0 | 0 | (100) |
| Utilisation factor for loss hm | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.81 | 0.88 | 0.86 | 0 | 0 | 0 | 0 | (101) |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 715.22 | 614.17 | 608.76 | 0 | 0 | 0 | 0 | (102) |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 855.21 | 819.03 | 771.37 | 0 | 0 | 0 | 0 | (103) |

*Space cooling requirement for month, whole dwelling, continuous ( kWh) = 0.024 x [(103)m – (102)m ] x (41)m*
set (104)m to zero if (104)m < 3 × (98)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (104)m= | 0 | 0 | 0 | 0 | 0 | 100.79 | 152.42 | 120.98 | 0 | 0 | 0 | 0 | |

Total = Sum(104)$_{5...8}$ = 374.19 (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 | 25.2 | 38.1 | 30.25 | 0 | 0 | 0 | 0 | |

Total = Sum(107)$_{5...8}$ = 93.55 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.26 (108)

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

Fabric Energy Efficiency (99) + (108) = 52.79 (109)

**Target Fabric Energy Efficiency (TFEE)** 60.71 (109)

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

STUDIO11 architecture

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Chloe Hewitt | **Stroma Number:** | STRO029693 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.6 |

## Property Address: Plot 76

**Address :** Plot 76, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 37.21 | (1a) x | 2.4 | (2a) = | 89.3 | (3a) |
| Ground floor | 37.21 | (1b) x | 2.61 | (2b) = | 97.12 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 74.42 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 186.42 | (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) = | 0.16 (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) | | 0.41 (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) = | | 0.41 (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 sta

STUDIO11 architecture

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.52 | 0.51 | 0.5 | 0.45 | 0.44 | 0.39 | 0.39 | 0.38 | 0.41 | 0.44 | 0.46 | 0.48 |

*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= | 0.64 | 0.63 | 0.63 | 0.6 | 0.6 | 0.58 | 0.58 | 0.57 | 0.58 | 0.6 | 0.61 | 0.62 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.64 | 0.63 | 0.63 | 0.6 | 0.6 | 0.58 | 0.58 | 0.57 | 0.58 | 0.6 | 0.61 | 0.62 |

(25)

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2.12 | x | 1.2 | = | 2.544 | | | (26) |
| Windows Type 1 | | | 1.62 | x1/[1/( 1.2 )+ 0.04] | | = | 1.85 | | | (27) |
| Windows Type 2 | | | 1.1 | x1/[1/( 1.2 )+ 0.04] | | = | 1.26 | | | (27) |
| Windows Type 3 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 4 | | | 1.1 | x1/[1/( 1.2 )+ 0.04] | | = | 1.26 | | | (27) |
| Windows Type 5 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 6 | | | 0.66 | x1/[1/( 1.2 )+ 0.04] | | = | 0.76 | | | (27) |
| Windows Type 7 | | | 0.66 | x1/[1/( 1.2 )+ 0.04] | | = | 0.76 | | | (27) |
| Windows Type 8 | | | 3.78 | x1/[1/( 1.2 )+ 0.04] | | = | 4.33 | | | (27) |
| Floor | | | 37.21 | x | 0.12 | = | 4.4652 | | | (28) |
| Walls | 126.95 | 13.92 | 113.03 | x | 0.24 | = | 27.13 | | | (29) |
| Roof | 37.21 | 0 | 37.21 | x | 0.09 | = | 3.35 | | | (30) |
| Total area of elements, m² | | | 201.37 | | | | | | | (31) |
| Party wall | | | 40.24 | x | 0 | = | 0 | | | (32) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 51 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 11718.24 (34)

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

*can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K — 16.05 (36)

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

Total fabric heat loss (33) + (36) = 67.05 (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= | 39.2 | 38.88 | 38.55 | 37.04 | 36.76 | 35.45 | 35.45 | 35.2 | 35.95 | 36.76 | 37.33 | 37.93 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 106.25 | 105.92 | 105.6 | 104.09 | 103.81 | 102.49 | 102.49 | 102.25 | 103 | 103.81 | 104.38 | 104.98 | |

Average = Sum(39)$_{1...12}$ /12= 104.09 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.43 | 1.42 | 1.42 | 1.4 | 1.39 | 1.38 | 1.38 | 1.37 | 1.38 | 1.39 | 1.4 | 1.41 | |

Average = Sum(40)$_{1...12}$ /12= 1.4 (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 — 2.35 (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 — 89.98 (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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 98.97 | 95.38 | 91.78 | 88.18 | 84.58 | 80.98 | 80.98 | 84.58 | 88.18 | 91.78 | 95.38 | 98.97 | |

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

Total = Sum(44)$_{1...12}$ = 1079.72 (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= | 146.78 | 128.37 | 132.47 | 115.49 | 110.81 | 95.62 | 88.61 | 101.68 | 102.9 | 119.91 | 130.9 | 142.14 | |

Total = Sum(45)$_{1...12}$ = 1415.68 (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)

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Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

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

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

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

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

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

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

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

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 124.76 | 109.12 | 112.6 | 98.17 | 94.19 | 81.28 | 75.32 | 86.43 | 87.46 | 101.93 | 111.26 | 120.82 | (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= | 124.76 | 109.12 | 112.6 | 98.17 | 94.19 | 81.28 | 75.32 | 86.43 | 87.46 | 101.93 | 111.26 | 120.82 | |

Output from water heater (annual)$_{1...12}$ 1203.33 (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= | 31.19 | 27.28 | 28.15 | 24.54 | 23.55 | 20.32 | 18.83 | 21.61 | 21.87 | 25.48 | 27.82 | 30.21 | (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= | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 18.77 | 16.68 | 13.56 | 10.27 | 7.67 | 6.48 | 7 | 9.1 | 12.21 | 15.51 | 18.1 | 19.3 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 207.39 | 209.54 | 204.11 | 192.57 | 178 | 164.3 | 155.15 | 153 | 158.42 | 169.97 | 184.54 | 198.24 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | (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= | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 41.92 | 40.59 | 37.84 | 34.09 | 31.65 | 28.22 | 25.31 | 29.04 | 30.37 | 34.25 | 38.63 | 40.6 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 326.31 | 325.03 | 313.74 | 295.15 | 275.55 | 257.23 | 245.69 | 249.37 | 259.23 | 277.95 | 299.5 | 316.36 | (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 sta




| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 36.79 | x | 0.63 | x | 0.7 | = | 7.42 | (77) |
| 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 | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 62.67 | x | 0.63 | x | 0.7 | = | 12.64 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 62.67 | x | 0.63 | x | 0.7 | = | 72.4 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 85.75 | x | 0.63 | x | 0.7 | = | 17.3 | (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 | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 106.25 | x | 0.63 | x | 0.7 | = | 21.43 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 106.25 | x | 0.63 | x | 0.7 | = | 122.74 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 119.01 | x | 0.63 | x | 0.7 | = | 24 | (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 | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 118.15 | x | 0.63 | x | 0.7 | = | 23.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 118.15 | x | 0.63 | x | 0.7 | = | 136.49 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 113.91 | x | 0.63 | x | 0.7 | = | 22.98 | (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 | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 104.39 | x | 0.63 | x | 0.7 | = | 21.06 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 104.39 | x | 0.63 | x | 0.7 | = | 120.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 92.85 | x | 0.63 | x | 0.7 | = | 18.73 | (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 | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 69.27 | x | 0.63 | x | 0.7 | = | 13.97 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 69.27 | x | 0.63 | x | 0.7 | = | 80.02 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 44.07 | x | 0.63 | x | 0.7 | = | 8.89 | (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 | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 31.49 | x | 0.63 | x | 0.7 | = | 6.35 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 31.49 | x | 0.63 | x | 0.7 | = | 36.38 | (77) |
| Southwest 0.9x | 0.77 | x | 1.1 | x | 36.79 | | 0.63 | x | 0.7 | = | 12.37 | (79) |
| Southwest 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest 0.9x | 0.77 | x | 1.1 | x | 62.67 | | 0.63 | x | 0.7 | = | 21.07 | (79) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design sta

STUDIO11 architecture

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 85.75 | | 0.63 | x | 0.7 | = | 28.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 106.25 | | 0.63 | x | 0.7 | = | 35.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 119.01 | | 0.63 | x | 0.7 | = | 40.01 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 118.15 | | 0.63 | x | 0.7 | = | 39.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 113.91 | | 0.63 | x | 0.7 | = | 38.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 104.39 | | 0.63 | x | 0.7 | = | 35.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 92.85 | | 0.63 | x | 0.7 | = | 31.21 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 69.27 | | 0.63 | x | 0.7 | = | 23.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 44.07 | | 0.63 | x | 0.7 | = | 14.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 31.49 | | 0.63 | x | 0.7 | = | 10.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | (79) |
| Northwest | 0.9x | 0.77 | x | 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 | 1.1 | x | 11.28 | x | 0.63 | x | 0.7 | = | 3.79 | (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 | 1.1 | x | 22.97 | x | 0.63 | x | 0.7 | = | 7.72 | (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 | 1.1 | x | 41.38 | x | 0.63 | x | 0.7 | = | 13.91 | (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 | 1.1 | x | 67.96 | x | 0.63 | x | 0.7 | = | 22.85 | (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 | 1.1 | x | 91.35 | x | 0.63 | x | 0.7 | = | 30.71 | (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 | 1.1 | x | 97.38 | x | 0.63 | x | 0.7 | = | 32.74 | (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) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design sta

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 91.1 | x | 0.63 | x | 0.7 | = | 30.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.62 | x | 72.63 | x | 0.63 | x | 0.7 | = | 35.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 72.63 | x | 0.63 | x | 0.7 | = | 24.42 | (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 | 1.1 | x | 50.42 | x | 0.63 | x | 0.7 | = | 16.95 | (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 | 1.1 | x | 28.07 | x | 0.63 | x | 0.7 | = | 9.44 | (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 | 1.1 | x | 14.2 | x | 0.63 | x | 0.7 | = | 4.77 | (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) |
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.1 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 100.25 | 175.53 | 252.83 | 334.48 | 394.01 | 399.68 | 381.79 | 336.07 | 280.9 | 197.41 | 120.95 | 85.23 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 426.56 | 500.57 | 566.57 | 629.63 | 669.56 | 656.9 | 627.47 | 585.44 | 540.13 | 475.37 | 420.45 | 401.59 | (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 | 0.93 | 0.81 | 0.66 | 0.72 | 0.91 | 0.98 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.38 | 19.55 | 19.83 | 20.22 | 20.58 | 20.85 | 20.96 | 20.94 | 20.73 | 20.26 | 19.76 | 19.36 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.74 | 19.75 | 19.75 | 19.76 | 19.77 | 19.78 | 19.78 | 19.78 | 19.78 | 19.77 | 19.76 | 19.76 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.99 | 0.96 | 0.89 | 0.72 | 0.5 | 0.57 | 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= | 18.28 | 18.45 | 18.74 | 19.13 | 19.48 | 19.71 | 19.77 | 19.77 | 19.62 | 19.18 | 18.67 | 18.27 | (90) |

fLA = Living area ÷ (4) = 0.27 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.58 | 18.75 | 19.03 | 19.42 | 19.77 | 20.01 | 20.09 | 20.08 | 19.92 | 19.47 | 18.96 | 18.56 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.58 | 18.75 | 19.03 | 19.42 | 19.77 | 20.01 | 20.09 | 20.08 | 19.92 | 19.47 | 18.96 | 18.56 | (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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design sta

STUDIO11 architecture

Utilisation factor for gains, hm:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (94)m= | 1 | 0.99 | 0.98 | 0.96 | 0.89 | 0.74 | 0.55 | 0.61 | 0.85 | 0.97 | 0.99 | 1 | (94) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 425.15 | 497.15 | 557.75 | 603.63 | 596.26 | 485.59 | 343.46 | 354.65 | 460.43 | 461.71 | 417.77 | 400.57 | (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= | 1516.77 | 1466.63 | 1323.27 | 1095.22 | 837.88 | 554.94 | 357.33 | 376.09 | 599.1 | 920.41 | 1238.04 | 1507.6 | (97) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 812.17 | 651.49 | 569.55 | 353.94 | 179.77 | 0 | 0 | 0 | 0 | 341.27 | 590.6 | 823.63 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4322.42 (98)

Space heating requirement in kWh/m²/year 58.08 (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 | 963.45 | 758.46 | 777.11 | 0 | 0 | 0 | 0 | (100) |
| Utilisation factor for loss hm | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.76 | 0.84 | 0.81 | 0 | 0 | 0 | 0 | (101) |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 734.2 | 639.63 | 630.03 | 0 | 0 | 0 | 0 | (102) |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 855.21 | 819.03 | 771.37 | 0 | 0 | 0 | 0 | (103) |

*Space cooling requirement for month, whole dwelling, continuous ( kWh) = 0.024 x [(103)m – (102)m ] x (41)m*
set (104)m to zero if (104)m < 3 × (98)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (104)m= | 0 | 0 | 0 | 0 | 0 | 87.12 | 133.47 | 105.16 | 0 | 0 | 0 | 0 | |

Total = Sum(104)$_{5...8}$ = 325.75 (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 | 21.78 | 33.37 | 26.29 | 0 | 0 | 0 | 0 | |

Total = Sum(107)$_{5...8}$ = 81.44 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.09 (108)

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

Fabric Energy Efficiency (99) + (108) = 59.18 (109)

# DER WorkSheet: New dwelling design stage

STUDIO11 architecture

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Chloe Hewitt | **Stroma Number:** | STRO029693 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.6 |

## Property Address: Plot 76

**Address :** Plot 76, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 37.21 | (1a) x | 2.4 | (2a) = | 89.3 | (3a) |
| Ground floor | 37.21 | (1b) x | 2.61 | (2b) = | 97.12 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 74.42 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 186.42 | (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) = | 0.16 (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) | | 0.41 (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) = | | 0.41 (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

STUDIO11 architecture

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.52 | 0.51 | 0.5 | 0.45 | 0.44 | 0.39 | 0.39 | 0.38 | 0.41 | 0.44 | 0.46 | 0.48 |

*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= | 0.64 | 0.63 | 0.63 | 0.6 | 0.6 | 0.58 | 0.58 | 0.57 | 0.58 | 0.6 | 0.61 | 0.62 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.64 | 0.63 | 0.63 | 0.6 | 0.6 | 0.58 | 0.58 | 0.57 | 0.58 | 0.6 | 0.61 | 0.62 |

(25)

## 3. Heat losses and heat loss parameter:

| **ELEMENT** | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2.12 | x | 1.2 | = | 2.544 | | | (26) |
| Windows Type 1 | | | 1.62 | x1/[1/( 1.2 )+ 0.04] | | = | 1.85 | | | (27) |
| Windows Type 2 | | | 1.1 | x1/[1/( 1.2 )+ 0.04] | | = | 1.26 | | | (27) |
| Windows Type 3 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 4 | | | 1.1 | x1/[1/( 1.2 )+ 0.04] | | = | 1.26 | | | (27) |
| Windows Type 5 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 6 | | | 0.66 | x1/[1/( 1.2 )+ 0.04] | | = | 0.76 | | | (27) |
| Windows Type 7 | | | 0.66 | x1/[1/( 1.2 )+ 0.04] | | = | 0.76 | | | (27) |
| Windows Type 8 | | | 3.78 | x1/[1/( 1.2 )+ 0.04] | | = | 4.33 | | | (27) |
| Floor | | | 37.21 | x | 0.12 | = | 4.4652 | | | (28) |
| Walls | 126.95 | 13.92 | 113.03 | x | 0.24 | = | 27.13 | | | (29) |
| Roof | 37.21 | 0 | 37.21 | x | 0.09 | = | 3.35 | | | (30) |
| Total area of elements, m² | | | 201.37 | | | | | | | (31) |
| Party wall | | | 40.24 | x | 0 | = | 0 | | | (32) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 51 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 11718.24 (34)

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

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*can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K — 16.05 (36)

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

Total fabric heat loss (33) + (36) = 67.05 (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= | 39.2 | 38.88 | 38.55 | 37.04 | 36.76 | 35.45 | 35.45 | 35.2 | 35.95 | 36.76 | 37.33 | 37.93 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 106.25 | 105.92 | 105.6 | 104.09 | 103.81 | 102.49 | 102.49 | 102.25 | 103 | 103.81 | 104.38 | 104.98 | |

Average = Sum(39)$_{1...12}$ /12= 104.09 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.43 | 1.42 | 1.42 | 1.4 | 1.39 | 1.38 | 1.38 | 1.37 | 1.38 | 1.39 | 1.4 | 1.41 | |

Average = Sum(40)$_{1...12}$ /12= 1.4 (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 — 2.35 (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 — 89.98 (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= | 98.97 | 95.38 | 91.78 | 88.18 | 84.58 | 80.98 | 80.98 | 84.58 | 88.18 | 91.78 | 95.38 | 98.97 | |

Total = Sum(44)$_{1...12}$ = 1079.72 (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= | 146.78 | 128.37 | 132.47 | 115.49 | 110.81 | 95.62 | 88.61 | 101.68 | 102.9 | 119.91 | 130.9 | 142.14 | |

Total = Sum(45)$_{1...12}$ = 1415.68 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 22.02 | 19.26 | 19.87 | 17.32 | 16.62 | 14.34 | 13.29 | 15.25 | 15.43 | 17.99 | 19.63 | 21.32 | (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)

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| | | | |
|---|---|---|---|
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 0 | (54) |
| Enter (50) or (54) in (55) | | 0 | (55) |

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

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

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

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

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

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 34.19 | 30.87 | 34.17 | 33.05 | 34.15 | 33.03 | 34.13 | 34.14 | 33.04 | 34.16 | 33.07 | 34.18 | (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= | 180.96 | 159.24 | 166.63 | 148.54 | 144.96 | 128.66 | 122.74 | 135.82 | 135.94 | 154.07 | 163.97 | 176.33 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)
(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 180.96 | 159.24 | 166.63 | 148.54 | 144.96 | 128.66 | 122.74 | 135.82 | 135.94 | 154.07 | 163.97 | 176.33 | |

Output from water heater (annual)$_{1...12}$ — 1817.86 — (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= | 57.35 | 50.4 | 52.59 | 46.66 | 45.38 | 40.05 | 37.99 | 42.34 | 42.47 | 48.41 | 51.79 | 55.81 | (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= | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 18.77 | 16.68 | 13.56 | 10.27 | 7.67 | 6.48 | 7 | 9.1 | 12.21 | 15.51 | 18.1 | 19.3 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 207.39 | 209.54 | 204.11 | 192.57 | 178 | 164.3 | 155.15 | 153 | 158.42 | 169.97 | 184.54 | 198.24 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | (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= | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 77.08 | 75 | 70.68 | 64.81 | 61 | 55.63 | 51.07 | 56.91 | 58.99 | 65.07 | 71.93 | 75.01 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 364.47 | 362.44 | 349.59 | 328.87 | 307.9 | 287.64 | 274.45 | 280.24 | 290.85 | 311.77 | 335.8 | 353.77 | (73) |

## 6. Solar gains:

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

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| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 36.79 | x | 0.63 | x | 0.7 | = | 7.42 | (77) |
| 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 | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 62.67 | x | 0.63 | x | 0.7 | = | 12.64 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 62.67 | x | 0.63 | x | 0.7 | = | 72.4 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 85.75 | x | 0.63 | x | 0.7 | = | 17.3 | (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 | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 106.25 | x | 0.63 | x | 0.7 | = | 21.43 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 106.25 | x | 0.63 | x | 0.7 | = | 122.74 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 119.01 | x | 0.63 | x | 0.7 | = | 24 | (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 | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 118.15 | x | 0.63 | x | 0.7 | = | 23.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 118.15 | x | 0.63 | x | 0.7 | = | 136.49 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 113.91 | x | 0.63 | x | 0.7 | = | 22.98 | (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 | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 104.39 | x | 0.63 | x | 0.7 | = | 21.06 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 104.39 | x | 0.63 | x | 0.7 | = | 120.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 92.85 | x | 0.63 | x | 0.7 | = | 18.73 | (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 | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 69.27 | x | 0.63 | x | 0.7 | = | 13.97 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 69.27 | x | 0.63 | x | 0.7 | = | 80.02 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 44.07 | x | 0.63 | x | 0.7 | = | 8.89 | (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 | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 31.49 | x | 0.63 | x | 0.7 | = | 6.35 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 31.49 | x | 0.63 | x | 0.7 | = | 36.38 | (77) |
| Southwest 0.9x | 0.77 | x | 1.1 | x | 36.79 | | 0.63 | x | 0.7 | = | 12.37 | (79) |
| Southwest 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest 0.9x | 0.77 | x | 1.1 | x | 62.67 | | 0.63 | x | 0.7 | = | 21.07 | (79) |

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 85.75 | | 0.63 | x | 0.7 | = | 28.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 106.25 | | 0.63 | x | 0.7 | = | 35.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 119.01 | | 0.63 | x | 0.7 | = | 40.01 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 118.15 | | 0.63 | x | 0.7 | = | 39.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 113.91 | | 0.63 | x | 0.7 | = | 38.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 104.39 | | 0.63 | x | 0.7 | = | 35.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 92.85 | | 0.63 | x | 0.7 | = | 31.21 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 69.27 | | 0.63 | x | 0.7 | = | 23.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 44.07 | | 0.63 | x | 0.7 | = | 14.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 31.49 | | 0.63 | x | 0.7 | = | 10.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | (79) |
| Northwest | 0.9x | 0.77 | x | 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 | 1.1 | x | 11.28 | x | 0.63 | x | 0.7 | = | 3.79 | (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 | 1.1 | x | 22.97 | x | 0.63 | x | 0.7 | = | 7.72 | (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 | 1.1 | x | 41.38 | x | 0.63 | x | 0.7 | = | 13.91 | (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 | 1.1 | x | 67.96 | x | 0.63 | x | 0.7 | = | 22.85 | (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 | 1.1 | x | 91.35 | x | 0.63 | x | 0.7 | = | 30.71 | (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 | 1.1 | x | 97.38 | x | 0.63 | x | 0.7 | = | 32.74 | (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) |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 91.1 | x | 0.63 | x | 0.7 | = | 30.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.62 | x | 72.63 | x | 0.63 | x | 0.7 | = | 35.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 72.63 | x | 0.63 | x | 0.7 | = | 24.42 | (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 | 1.1 | x | 50.42 | x | 0.63 | x | 0.7 | = | 16.95 | (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 | 1.1 | x | 28.07 | x | 0.63 | x | 0.7 | = | 9.44 | (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 | 1.1 | x | 14.2 | x | 0.63 | x | 0.7 | = | 4.77 | (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) |
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.1 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 100.25 | 175.53 | 252.83 | 334.48 | 394.01 | 399.68 | 381.79 | 336.07 | 280.9 | 197.41 | 120.95 | 85.23 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 464.72 | 537.98 | 602.41 | 663.35 | 701.9 | 687.31 | 656.23 | 616.31 | 571.75 | 509.18 | 456.75 | 439.01 | (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 | 0.64 | 0.69 | 0.89 | 0.98 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.43 | 19.59 | 19.87 | 20.26 | 20.61 | 20.87 | 20.96 | 20.95 | 20.76 | 20.3 | 19.8 | 19.4 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.74 | 19.75 | 19.75 | 19.76 | 19.77 | 19.78 | 19.78 | 19.78 | 19.78 | 19.77 | 19.76 | 19.76 | (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 | 0.7 | 0.48 | 0.54 | 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= | 17.67 | 17.92 | 18.33 | 18.89 | 19.37 | 19.69 | 19.77 | 19.76 | 19.57 | 18.96 | 18.23 | 17.65 | (90) |

fLA = Living area ÷ (4) = 0.27 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.14 | 18.36 | 18.74 | 19.25 | 19.7 | 20 | 20.09 | 20.08 | 19.89 | 19.31 | 18.65 | 18.12 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.99 | 18.21 | 18.59 | 19.1 | 19.55 | 19.85 | 19.94 | 19.93 | 19.74 | 19.16 | 18.5 | 17.97 | (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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

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Utilisation factor for gains, hm:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (94)m= | 0.99 | 0.99 | 0.98 | 0.95 | 0.87 | 0.7 | 0.51 | 0.56 | 0.82 | 0.96 | 0.99 | 1 | (94) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 462.22 | 532.42 | 589.22 | 627.65 | 608.79 | 483.29 | 332.06 | 345.4 | 468.37 | 488.52 | 452.13 | 437.14 | (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= | 1454.45 | 1410.35 | 1276.82 | 1061.9 | 815.28 | 538.36 | 341.89 | 360.65 | 580.73 | 888.99 | 1189.61 | 1445.06 | (97) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 738.22 | 589.97 | 511.58 | 312.66 | 153.63 | 0 | 0 | 0 | 0 | 297.95 | 530.99 | 749.89 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3884.89 (98)

Space heating requirement in kWh/m²/year 52.2 (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) | 738.22 | 589.97 | 511.58 | 312.66 | 153.63 | 0 | 0 | 0 | 0 | 297.95 | 530.99 | 749.89 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 818.43 | 654.07 | 567.16 | 346.63 | 170.32 | 0 | 0 | 0 | 0 | 330.32 | 588.68 | 831.36 | (211) |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 4306.97 (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)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 180.96 | 159.24 | 166.63 | 148.54 | 144.96 | 128.66 | 122.74 | 135.82 | 135.94 | 154.07 | 163.97 | 176.33 | |

Efficiency of water heater 87 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 89.55 | 89.5 | 89.39 | 89.14 | 88.62 | 87 | 87 | 87 | 87 | 89.08 | 89.42 | 89.57 | (217) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 202.08 | 177.92 | 186.41 | 166.63 | 163.58 | 147.88 | 141.08 | 156.11 | 156.25 | 172.95 | 183.36 | 196.85 | |

Total = Sum(219a)$_{1...12}$ = 2051.11 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 4306.97 |
| Water heating fuel used | | 2051.11 |
| Electricity for pumps, fans and electric keep-hot | | |

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| | | | |
|---|---|---|---|
| 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 | | 331.56 | (232) |
| Electricity generated by PVs | | -803.2 | (233) |

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

| | Energy kWh/year | | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) | x | 0.216 | = | 930.31 | (261) |
| Space heating (secondary) | (215) | x | 0.519 | = | 0 | (263) |
| Water heating | (219) | x | 0.216 | = | 443.04 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 1373.35 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) | x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) | x | 0.519 | = | 172.08 | (268) |
| Energy saving/generation technologies Item 1 | | | 0.519 | = | -416.86 | (269) |
| Total CO2, kg/year | sum of (265)…(271) = | | | | 1167.49 | (272) |
| **Dwelling CO2 Emission Rate** | (272) ÷ (4) = | | | | 15.69 | (273) |
| EI rating (section 14) | | | | | 87 | (274) |

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## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Chloe Hewitt | **Stroma Number:** | STRO029693 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.6 |

## Property Address: Plot 76

**Address :** Plot 76, Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 37.21 | (1a) x | 2.4 | (2a) = | 89.3 | (3a) |
| Ground floor | 37.21 | (1b) x | 2.61 | (2b) = | 97.12 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 74.42 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 186.42 | (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) = | 0.16 (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) | | 0.41 (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) = | | 0.41 (21) |

Infiltration rate modified for monthly wind speed

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.52 | 0.51 | 0.5 | 0.45 | 0.44 | 0.39 | 0.39 | 0.38 | 0.41 | 0.44 | 0.46 | 0.48 |

*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= | 0.64 | 0.63 | 0.63 | 0.6 | 0.6 | 0.58 | 0.58 | 0.57 | 0.58 | 0.6 | 0.61 | 0.62 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.64 | 0.63 | 0.63 | 0.6 | 0.6 | 0.58 | 0.58 | 0.57 | 0.58 | 0.6 | 0.61 | 0.62 |

(25)

## 3. Heat losses and heat loss parameter:

| **ELEMENT** | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2.12 | x | 1.2 | = | 2.544 | | | (26) |
| Windows Type 1 | | | 1.62 | x1/[1/( 1.4 )+ 0.04] | | = | 2.15 | | | (27) |
| Windows Type 2 | | | 1.1 | x1/[1/( 1.4 )+ 0.04] | | = | 1.46 | | | (27) |
| Windows Type 3 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 4 | | | 1.1 | x1/[1/( 1.4 )+ 0.04] | | = | 1.46 | | | (27) |
| Windows Type 5 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 6 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 7 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 8 | | | 3.78 | x1/[1/( 1.4 )+ 0.04] | | = | 5.01 | | | (27) |
| Floor | | | 37.21 | x | 0.13 | = | 4.8373 | | | (28) |
| Walls | 126.95 | 13.92 | 113.03 | x | 0.18 | = | 20.35 | | | (29) |
| Roof | 37.21 | 0 | 37.21 | x | 0.13 | = | 4.84 | | | (30) |
| Total area of elements, m² | | | 201.37 | | | | | | | (31) |
| Party wall | | | 40.24 | 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) = 48.21 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 11718.24 (34)

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

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*can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K — 10.23 (36)

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

Total fabric heat loss (33) + (36) = 58.44 (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= | 39.2 | 38.88 | 38.55 | 37.04 | 36.76 | 35.45 | 35.45 | 35.2 | 35.95 | 36.76 | 37.33 | 37.93 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 97.64 | 97.31 | 96.99 | 95.48 | 95.2 | 93.88 | 93.88 | 93.64 | 94.39 | 95.2 | 95.77 | 96.37 | |

Average = Sum(39)$_{1...12}$ /12= 95.48 (39)

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

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

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 — 2.35 (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 — 89.98 (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= | 98.97 | 95.38 | 91.78 | 88.18 | 84.58 | 80.98 | 80.98 | 84.58 | 88.18 | 91.78 | 95.38 | 98.97 | |

Total = Sum(44)$_{1...12}$ = 1079.72 (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= | 146.78 | 128.37 | 132.47 | 115.49 | 110.81 | 95.62 | 88.61 | 101.68 | 102.9 | 119.91 | 130.9 | 142.14 | |

Total = Sum(45)$_{1...12}$ = 1415.68 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 22.02 | 19.26 | 19.87 | 17.32 | 16.62 | 14.34 | 13.29 | 15.25 | 15.43 | 17.99 | 19.63 | 21.32 | (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)

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| | | | |
|---|---|---|---|
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 0 | (54) |
| Enter (50) or (54) in (55) | | 0 | (55) |

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

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

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

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

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

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.44 | 43.9 | 46.77 | 43.48 | 43.1 | 39.93 | 41.27 | 43.1 | 43.48 | 46.77 | 47.03 | 50.44 | (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= | 197.21 | 172.27 | 179.24 | 158.97 | 153.91 | 135.56 | 129.88 | 144.78 | 146.38 | 166.68 | 177.93 | 192.58 | (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= | 197.21 | 172.27 | 179.24 | 158.97 | 153.91 | 135.56 | 129.88 | 144.78 | 146.38 | 166.68 | 177.93 | 192.58 | |

Output from water heater (annual)$_{1...12}$ — 1955.39 — (64)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 61.41 | 53.66 | 55.74 | 49.27 | 47.62 | 41.78 | 39.78 | 44.58 | 45.08 | 51.56 | 55.28 | 59.87 | (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= | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | 117.42 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 18.77 | 16.68 | 13.56 | 10.27 | 7.67 | 6.48 | 7 | 9.1 | 12.21 | 15.51 | 18.1 | 19.3 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 207.39 | 209.54 | 204.11 | 192.57 | 178 | 164.3 | 155.15 | 153 | 158.42 | 169.97 | 184.54 | 198.24 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | 34.74 | (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= | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | -93.94 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 82.54 | 79.85 | 74.92 | 68.43 | 64.01 | 58.03 | 53.47 | 59.92 | 62.62 | 69.31 | 76.78 | 80.47 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 369.93 | 367.29 | 353.82 | 332.5 | 310.9 | 290.03 | 276.84 | 283.25 | 294.48 | 316.01 | 340.65 | 359.23 | (73) |

## 6. Solar gains:

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

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| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 36.79 | x | 0.63 | x | 0.7 | = | 7.42 | (77) |
| 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 | 62.67 | x | 0.63 | x | 0.7 | = | 27.58 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 62.67 | x | 0.63 | x | 0.7 | = | 12.64 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 62.67 | x | 0.63 | x | 0.7 | = | 72.4 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 85.75 | x | 0.63 | x | 0.7 | = | 37.74 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 85.75 | x | 0.63 | x | 0.7 | = | 17.3 | (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 | 106.25 | x | 0.63 | x | 0.7 | = | 46.76 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 106.25 | x | 0.63 | x | 0.7 | = | 21.43 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 106.25 | x | 0.63 | x | 0.7 | = | 122.74 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 119.01 | x | 0.63 | x | 0.7 | = | 52.37 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 119.01 | x | 0.63 | x | 0.7 | = | 24 | (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 | 118.15 | x | 0.63 | x | 0.7 | = | 52 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 118.15 | x | 0.63 | x | 0.7 | = | 23.83 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 118.15 | x | 0.63 | x | 0.7 | = | 136.49 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 113.91 | x | 0.63 | x | 0.7 | = | 50.13 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 113.91 | x | 0.63 | x | 0.7 | = | 22.98 | (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 | 104.39 | x | 0.63 | x | 0.7 | = | 45.94 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 104.39 | x | 0.63 | x | 0.7 | = | 21.06 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 104.39 | x | 0.63 | x | 0.7 | = | 120.59 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 92.85 | x | 0.63 | x | 0.7 | = | 40.86 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 92.85 | x | 0.63 | x | 0.7 | = | 18.73 | (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 | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 69.27 | x | 0.63 | x | 0.7 | = | 13.97 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 69.27 | x | 0.63 | x | 0.7 | = | 80.02 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 44.07 | x | 0.63 | x | 0.7 | = | 8.89 | (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 | 31.49 | x | 0.63 | x | 0.7 | = | 13.86 | (77) |
| Southeast 0.9x | 0.77 | x | 0.66 | x | 31.49 | x | 0.63 | x | 0.7 | = | 6.35 | (77) |
| Southeast 0.9x | 0.77 | x | 3.78 | x | 31.49 | x | 0.63 | x | 0.7 | = | 36.38 | (77) |
| Southwest 0.9x | 0.77 | x | 1.1 | x | 36.79 | | 0.63 | x | 0.7 | = | 12.37 | (79) |
| Southwest 0.9x | 0.77 | x | 0.66 | x | 36.79 | | 0.63 | x | 0.7 | = | 7.42 | (79) |
| Southwest 0.9x | 0.77 | x | 1.1 | x | 62.67 | | 0.63 | x | 0.7 | = | 21.07 | (79) |

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 62.67 | | 0.63 | x | 0.7 | = | 12.64 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 85.75 | | 0.63 | x | 0.7 | = | 28.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 85.75 | | 0.63 | x | 0.7 | = | 17.3 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 106.25 | | 0.63 | x | 0.7 | = | 35.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 106.25 | | 0.63 | x | 0.7 | = | 21.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 119.01 | | 0.63 | x | 0.7 | = | 40.01 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 119.01 | | 0.63 | x | 0.7 | = | 24 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 118.15 | | 0.63 | x | 0.7 | = | 39.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 118.15 | | 0.63 | x | 0.7 | = | 23.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 113.91 | | 0.63 | x | 0.7 | = | 38.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 113.91 | | 0.63 | x | 0.7 | = | 22.98 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 104.39 | | 0.63 | x | 0.7 | = | 35.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 104.39 | | 0.63 | x | 0.7 | = | 21.06 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 92.85 | | 0.63 | x | 0.7 | = | 31.21 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 92.85 | | 0.63 | x | 0.7 | = | 18.73 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 69.27 | | 0.63 | x | 0.7 | = | 23.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 69.27 | | 0.63 | x | 0.7 | = | 13.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 44.07 | | 0.63 | x | 0.7 | = | 14.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 44.07 | | 0.63 | x | 0.7 | = | 8.89 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.1 | x | 31.49 | | 0.63 | x | 0.7 | = | 10.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.66 | x | 31.49 | | 0.63 | x | 0.7 | = | 6.35 | (79) |
| Northwest | 0.9x | 0.77 | x | 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 | 1.1 | x | 11.28 | x | 0.63 | x | 0.7 | = | 3.79 | (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 | 1.1 | x | 22.97 | x | 0.63 | x | 0.7 | = | 7.72 | (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 | 1.1 | x | 41.38 | x | 0.63 | x | 0.7 | = | 13.91 | (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 | 1.1 | x | 67.96 | x | 0.63 | x | 0.7 | = | 22.85 | (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 | 1.1 | x | 91.35 | x | 0.63 | x | 0.7 | = | 30.71 | (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 | 1.1 | x | 97.38 | x | 0.63 | x | 0.7 | = | 32.74 | (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) |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 91.1 | x | 0.63 | x | 0.7 | = | 30.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.62 | x | 72.63 | x | 0.63 | x | 0.7 | = | 35.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 72.63 | x | 0.63 | x | 0.7 | = | 24.42 | (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 | 1.1 | x | 50.42 | x | 0.63 | x | 0.7 | = | 16.95 | (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 | 1.1 | x | 28.07 | x | 0.63 | x | 0.7 | = | 9.44 | (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 | 1.1 | x | 14.2 | x | 0.63 | x | 0.7 | = | 4.77 | (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) |
| Northwest | 0.9x | 0.77 | x | 1.1 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.1 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 100.25 | 175.53 | 252.83 | 334.48 | 394.01 | 399.68 | 381.79 | 336.07 | 280.9 | 197.41 | 120.95 | 85.23 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 470.18 | 542.82 | 606.65 | 666.98 | 704.91 | 689.71 | 658.63 | 619.32 | 575.38 | 513.42 | 461.59 | 444.47 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.99 | 0.96 | 0.9 | 0.76 | 0.6 | 0.65 | 0.87 | 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 | 19.74 | 20.01 | 20.37 | 20.69 | 20.91 | 20.98 | 20.97 | 20.81 | 20.4 | 19.93 | 19.55 | (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 | 19.87 | 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 | 0.95 | 0.86 | 0.67 | 0.46 | 0.51 | 0.8 | 0.96 | 0.99 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.95 | 18.19 | 18.58 | 19.11 | 19.55 | 19.81 | 19.86 | 19.86 | 19.71 | 19.16 | 18.48 | 17.93 | (90) |

fLA = Living area ÷ (4) = 0.27 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.38 | 18.61 | 18.96 | 19.45 | 19.85 | 20.1 | 20.16 | 20.15 | 20.01 | 19.49 | 18.86 | 18.36 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.38 | 18.61 | 18.96 | 19.45 | 19.85 | 20.1 | 20.16 | 20.15 | 20.01 | 19.49 | 18.86 | 18.36 | (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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

# TER WorkSheet: New dwelling design stage

STUDIO11 architecture

Utilisation factor for gains, hm:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (94)m= | 0.99 | 0.99 | 0.98 | 0.94 | 0.86 | 0.69 | 0.5 | 0.55 | 0.81 | 0.96 | 0.99 | 1 | (94) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 467.78 | 537.35 | 593.26 | 629.53 | 605.68 | 474.79 | 327.15 | 340.42 | 465.96 | 492.06 | 457.06 | 442.7 | (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= | 1375.19 | 1333.7 | 1208.95 | 1007.02 | 776.25 | 516.49 | 334.23 | 351.62 | 557.57 | 846.31 | 1126.53 | 1364.8 | (97) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 675.11 | 535.15 | 458.07 | 271.79 | 126.9 | 0 | 0 | 0 | 0 | 263.56 | 482.02 | 686.05 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3498.65 (98)

Space heating requirement in kWh/m²/year 47.01 (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) | 675.11 | 535.15 | 458.07 | 271.79 | 126.9 | 0 | 0 | 0 | 0 | 263.56 | 482.02 | 686.05 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) (211) | 722.82 | 572.96 | 490.44 | 291 | 135.87 | 0 | 0 | 0 | 0 | 282.19 | 516.08 | 734.53 | |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3745.88 (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)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 197.21 | 172.27 | 179.24 | 158.97 | 153.91 | 135.56 | 129.88 | 144.78 | 146.38 | 166.68 | 177.93 | 192.58 | |

Efficiency of water heater 80.3 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 87.9 | 87.71 | 87.31 | 86.39 | 84.57 | 80.3 | 80.3 | 80.3 | 80.3 | 86.2 | 87.43 | 87.97 | (217) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 224.36 | 196.4 | 205.28 | 184.02 | 182 | 168.82 | 161.74 | 180.3 | 182.29 | 193.37 | 203.5 | 218.9 | |

Total = Sum(219a)$_{1...12}$ = 2300.97 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 3745.88 |
| Water heating fuel used | | 2300.97 |
| Electricity for pumps, fans and electric keep-hot | | |

# TER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| 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 | | 331.56 | (232) |

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

| | Energy kWh/year | | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | | 0.216 | = | 809.11 | (261) |
| Space heating (secondary) | (215) x | | 0.519 | = | 0 | (263) |
| Water heating | (219) x | | 0.216 | = | 497.01 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 1306.12 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | | 0.519 | = | 172.08 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | | 1517.12 | (272) |

**TER =** 20.39 (273)

# SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on Friday, March 3, 2017

STUDIO11 architecture

## Property Details: Plot 76

| | |
|---|---|
| **Dwelling type:** | Semi-detached 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:** | 184.56 | **(P1)** |
| **Transmission heat loss coefficient:** | 67 | |
| **Summer heat loss coefficient:** | 251.6 | **(P2)** |

## Overhangs:

| Orientation: | Ratio: | Z_overhangs: |
|---|---|---|
| North West (W1 ) | 0 | 1 |
| South West (W2) | 0 | 1 |
| North West (W3) | 0 | 1 |
| North West (W4) | 0 | 1 |
| South East (W5) | 0 | 1 |
| South East (W6) | 0 | 1 |
| South West (W7) | 0 | 1 |
| South East (D2) | 0 | 1 |

## Solar shading:

| Orientation: | Z blinds: | Solar access: | Overhangs: | Z summer: | |
|---|---|---|---|---|---|
| North West (W1 ) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South West (W2) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (W3) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (W4) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South East (W5) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South East (W6) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South West (W7) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South East (D2) | 1 | 0.9 | 1 | 0.9 | **(P8)** |

## Solar gains:

| Orientation | | Area | Flux | g_ | FF | Shading | Gains |
|---|---|---|---|---|---|---|---|
| North West (W1 ) | 0.9 x | 1.62 | 91.1 | 0.63 | 0.7 | 0.9 | 52.72 |
| South West (W2) | 0.9 x | 1.1 | 113.91 | 0.63 | 0.7 | 0.9 | 44.76 |
| North West (W3) | 0.9 x | 1.44 | 91.1 | 0.63 | 0.7 | 0.9 | 46.86 |
| North West (W4) | 0.9 x | 1.1 | 91.1 | 0.63 | 0.7 | 0.9 | 35.8 |
| South East (W5) | 0.9 x | 1.44 | 113.91 | 0.63 | 0.7 | 0.9 | 58.59 |
| South East (W6) | 0.9 x | 0.66 | 113.91 | 0.63 | 0.7 | 0.9 | 26.86 |
| South West (W7) | 0.9 x | 0.66 | 113.91 | 0.63 | 0.7 | 0.9 | 26.86 |
| South East (D2) | 0.9 x | 3.78 | 113.91 | 0.63 | 0.7 | 0.9 | 153.81 |

# SAP 2012 Overheating Assessment

| | | | | |
|---|---|---|---|---|
| | | **Total** | 446.24 | **(P3/P4)** |

## Internal gains:

| | **June** | **July** | **August** | |
|---|---|---|---|---|
| Internal gains | 415.46 | 398.55 | 406.43 | |
| Total summer gains | 882.61 | 844.79 | 799.24 | **(P5)** |
| Summer gain/loss ratio | 3.51 | 3.36 | 3.18 | **(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 | 18.36 | 20.21 | 19.83 | **(P7)** |
| **Likelihood of high internal temperature** | **Not significant** | **Not significant** | **Not significant** | |

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