# 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 2:21:29 PM*

## Project Information:

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

## Dwelling Details:

**NEW DWELLING DESIGN STAGE** Total Floor Area: 74.42m²

**Site Reference :** Wardentree Lane **Plot Reference:** Plot 59

**Address :** Plot 59, 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) | 19.23 kg/m² | |
| Dwelling Carbon Dioxide Emission Rate (DER) | 13.39 kg/m² | **OK** |

## 1b TFEE and DFEE

| | | |
|---|---|---|
| Target Fabric Energy Efficiency (TFEE) | 54.0 kWh/m² | |
| Dwelling Fabric Energy Efficiency (DFEE) | 48.4 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):<br>Boiler systems with radiators or underfloor heating - mains gas<br>Brand name: Vaillant<br>Model: ecoTEC pro 30 H combi A<br>Model qualifier: VUW GB 306/5-3 (Combi)<br>Efficiency 89.3 % SEDBUK2009<br>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: South East | 1.62m² |
| Windows facing: South East | 1.44m² |
| Windows facing: South East | 1.1m² |
| Windows facing: North West | 1.44m² |
| Windows facing: North West | 0.66m² |
| Windows facing: North West | 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

## Property Details: Plot 59

| | |
|---|---|
| Address: | Plot 59, 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: | Mid-terrace |
| Year Completed: | 2016 |

| 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: | South East |

## Opening types:

| Name: | Source: | Type: | Glazing: | Argon: | Frame: |
|---|---|---|---|---|---|
| Front Door | Manufacturer | Half glazed | low-E, En = 0.05, soft coat | Yes | PVC-U |
| W1 | 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 | |
| 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 |
| 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 |
| D2 | 16mm or more | 0.7 | 0.63 | 1.2 | 3.78 | 1 |

| Name: | Type-Name: | Location: | Orient: | Width: | Height: |
|---|---|---|---|---|---|
| Front Door | | External Wall | South East | 1.01 | 2.1 |
| W1 | | External Wall | South East | 1.2 | 1.35 |
| W3 | | External Wall | South East | 1.2 | 1.2 |
| W4 | | External Wall | South East | 0.915 | 1.2 |
| W5 | | External Wall | North West | 1.2 | 1.2 |
| W6 | | External Wall | North West | 0.63 | 1.05 |
| D2 | | External Wall | North West | 1.8 | 2.1 |

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

## Opaque Elements:

# SAP Input

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| External Elements | | | | | | | |
| External Wall | 86.71 | 12.16 | 74.55 | 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 | 80.48 | | | | | | N/A |

## Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0562

| | Length | Psi-value | | |
|---|---|---|---|---|
| [Approved] | 7.96 | 0.5 | E1 | Steel lintel with perforated steel base plate |
| [Approved] | 5.15 | 0.04 | E3 | Sill |
| [Approved] | 19.8 | 0.05 | E4 | Jamb |
| [Approved] | 9.24 | 0.16 | E5 | Ground floor (normal) |
| [Approved] | 9.24 | 0.06 | E10 | Eaves (insulation at ceiling level) |
| [Approved] | 9.24 | 0.07 | E6 | Intermediate floor within a dwelling |
| [Approved] | 20.04 | 0.06 | E18 | Party wall between dwellings |
| | 16.1 | 0 | P1 | Ground floor |
| | 16.1 | 0 | P2 | Intermediate floor within a dwelling |
| | 16.1 | 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

## Main heating Control:

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

## Secondary heating system:

Secondary heating system: None

## Water heating:

Water heating:
From main heating system
Water code: 901
Fuel :mains gas

# SAP Input

No hot water cylinder
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

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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 59

**Address :** Plot 59, 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 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 3 | | | 1.1 | x1/[1/( 1.2 )+ 0.04] | | = | 1.26 | | | (27) |
| Windows Type 4 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 5 | | | 0.66 | x1/[1/( 1.2 )+ 0.04] | | = | 0.76 | | | (27) |
| Windows Type 6 | | | 3.78 | x1/[1/( 1.2 )+ 0.04] | | = | 4.33 | | | (27) |
| Floor | | | 37.21 | x | 0.12 | = | 4.4652 | | | (28) |
| Walls | 86.71 | 12.16 | 74.55 | x | 0.24 | = | 17.89 | | | (29) |
| Roof | 37.21 | 0 | 37.21 | x | 0.09 | = | 3.35 | | | (30) |
| Total area of elements, m² | | | 161.13 | | | | | | | (31) |
| Party wall | | | 80.48 | 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) = 39.75 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 11220.24 (34)

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

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f*

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*can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K — 9.06 (36)

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

Total fabric heat loss (33) + (36) = 48.8 (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= | 88.01 | 87.68 | 87.36 | 85.85 | 85.57 | 84.25 | 84.25 | 84.01 | 84.76 | 85.57 | 86.14 | 86.73 | |

Average = Sum(39)$_{1...12}$ /12= 85.85 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.18 | 1.18 | 1.17 | 1.15 | 1.15 | 1.13 | 1.13 | 1.13 | 1.14 | 1.15 | 1.16 | 1.17 | |

Average = Sum(40)$_{1...12}$ /12= 1.15 (40)

Number of days in month (Table 1a)

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

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

Assumed occupancy, N — 2.35 (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= | 48.03 | 42.66 | 34.69 | 26.26 | 19.63 | 16.57 | 17.91 | 23.28 | 31.24 | 39.67 | 46.3 | 49.36 | (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= | 536.05 | 531.81 | 511.43 | 479.9 | 447.7 | 418.84 | 401.95 | 409.95 | 428.09 | 459.83 | 495.07 | 521.65 | (73) |

## 6. Solar gains:

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

# SAP WorkSheet: New dwelling design stage

STUDIO11 architecture

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 1.62 | x | 36.79 | x | 0.63 | x | 0.7 | = | 18.22 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 62.67 | x | 0.63 | x | 0.7 | = | 31.03 | (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 | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 85.75 | x | 0.63 | x | 0.7 | = | 42.46 | (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 | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 106.25 | x | 0.63 | x | 0.7 | = | 52.6 | (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 | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 119.01 | x | 0.63 | x | 0.7 | = | 58.92 | (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 | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 118.15 | x | 0.63 | x | 0.7 | = | 58.5 | (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 | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 113.91 | x | 0.63 | x | 0.7 | = | 56.4 | (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 | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 104.39 | x | 0.63 | x | 0.7 | = | 51.68 | (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 | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 92.85 | x | 0.63 | x | 0.7 | = | 45.97 | (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 | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 69.27 | x | 0.63 | x | 0.7 | = | 34.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 44.07 | x | 0.63 | x | 0.7 | = | 21.82 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 31.49 | x | 0.63 | x | 0.7 | = | 15.59 | (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 | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | (81) |
| Northwest 0.9x | 0.77 | x | 3.78 | x | 11.28 | x | 0.63 | x | 0.7 | = | 13.03 | (81) |

# SAP WorkSheet: New dwelling design stage

STUDIO11 architecture

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 22.97 | x | 0.63 | x | 0.7 | = | 26.53 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 41.38 | x | 0.63 | x | 0.7 | = | 47.8 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 67.96 | x | 0.63 | x | 0.7 | = | 78.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 91.35 | x | 0.63 | x | 0.7 | = | 105.52 | (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 | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 97.38 | x | 0.63 | x | 0.7 | = | 112.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 91.1 | x | 0.63 | x | 0.7 | = | 105.24 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 72.63 | x | 0.63 | x | 0.7 | = | 83.9 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 50.42 | x | 0.63 | x | 0.7 | = | 58.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 28.07 | x | 0.63 | x | 0.7 | = | 32.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 14.2 | x | 0.63 | x | 0.7 | = | 16.4 | (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 | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 9.21 | x | 0.63 | x | 0.7 | = | 10.64 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 67.05 | 120.95 | 183.38 | 257.2 | 315.45 | 325.21 | 308.53 | 263.23 | 208.65 | 138.5 | 81.54 | 56.59 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 603.1 | 652.76 | 694.81 | 737.1 | 763.16 | 744.05 | 710.48 | 673.18 | 636.75 | 598.33 | 576.61 | 578.24 | (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 |
|---|---|---|---|---|---|---|---|---|---|---|---|

# SAP WorkSheet: New dwelling design stage

STUDIO11 architecture

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.99 | 0.99 | 0.98 | 0.94 | 0.85 | 0.68 | 0.51 | 0.56 | 0.8 | 0.95 | 0.99 | 0.99 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.91 | 20.04 | 20.26 | 20.56 | 20.82 | 20.96 | 20.99 | 20.99 | 20.9 | 20.6 | 20.21 | 19.89 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.93 | 19.94 | 19.94 | 19.96 | 19.96 | 19.97 | 19.97 | 19.98 | 19.97 | 19.96 | 19.95 | 19.95 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.99 | 0.98 | 0.97 | 0.92 | 0.8 | 0.59 | 0.4 | 0.44 | 0.72 | 0.93 | 0.98 | 0.99 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.5 | 18.69 | 19.02 | 19.46 | 19.78 | 19.95 | 19.97 | 19.97 | 19.89 | 19.51 | 18.95 | 18.49 | (90) |

fLA = Living area ÷ (4) = 0.27 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.88 | 19.05 | 19.35 | 19.75 | 20.06 | 20.22 | 20.24 | 20.24 | 20.16 | 19.8 | 19.29 | 18.86 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.73 | 18.9 | 19.2 | 19.6 | 19.91 | 20.07 | 20.09 | 20.09 | 20.01 | 19.65 | 19.14 | 18.71 | (93) |

## 8. Space heating requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.99 | 0.98 | 0.96 | 0.91 | 0.8 | 0.6 | 0.41 | 0.46 | 0.72 | 0.92 | 0.98 | 0.99 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 594.85 | 638.85 | 667.43 | 671.3 | 608.73 | 444.44 | 292.42 | 307.02 | 459.79 | 551.12 | 562.59 | 571.64 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1269.77 | 1227.75 | 1109.43 | 918.74 | 702.39 | 460.59 | 294.38 | 310.27 | 501.25 | 774.21 | 1037.04 | 1258.68 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 502.14 | 395.74 | 328.85 | 178.15 | 69.68 | 0 | 0 | 0 | 0 | 165.98 | 341.6 | 511.15 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2493.3 (98)

Space heating requirement in kWh/m²/year 33.5 (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) | | | | | | | | | | | | | |
| | 502.14 | 395.74 | 328.85 | 178.15 | 69.68 | 0 | 0 | 0 | 0 | 165.98 | 341.6 | 511.15 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 556.7 | 438.74 | 364.57 | 197.51 | 77.25 | 0 | 0 | 0 | 0 | 184.01 | 378.72 | 566.69 | |

Total (kWh/year) =Sum(211) = (211)

# SAP WorkSheet: New dwelling design stage

STUDIO11 architecture

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= | 89.33 | 89.26 | 89.1 | 88.72 | 88.01 | 87 | 87 | 87 | 87 | 88.63 | 89.14 | 89.36 |

(217)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 202.58 | 178.41 | 187.02 | 167.43 | 164.7 | 147.88 | 141.08 | 156.11 | 156.25 | 173.84 | 183.95 | 197.33 |

Total = Sum(219a)$_{1...12}$ = 2056.58 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 2764.19 |
| Water heating fuel used | | 2056.58 |
| Electricity for pumps, fans and electric keep-hot | | |
| central heating pump: | 30 (230c) | |
| boiler with a fan-assisted flue | 45 (230e) | |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | 75 (231) |
| Electricity for lighting | | 339.25 (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 = | 96.19 (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 = | 71.57 (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 = | 44.75 (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) = 236.46 (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] = 0.83 (257)

# SAP WorkSheet: New dwelling design stage

STUDIO11 architecture

**SAP rating (Section 12)** 88.4 (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 | = | 597.06 | (261) |
| Space heating (secondary) | (215) x | | 0.519 | = | 0 | (263) |
| Water heating | (219) x | | 0.216 | = | 444.22 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 1041.29 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | | 0.519 | = | 176.07 | (268) |
| Energy saving/generation technologies Item 1 | | | 0.519 | = | -416.86 | (269) |
| Total CO2, kg/year | | sum of (265)…(271) = | | | 839.43 | (272) |
| **CO2 emissions per m²** | | (272) ÷ (4) = | | | 11.28 | (273) |
| EI rating (section 14) | | | | | 91 | (274) |

## 13a. Primary Energy

| | Energy kWh/year | | Primary factor | | P. Energy kWh/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | | 1.22 | = | 3372.31 | (261) |
| Space heating (secondary) | (215) x | | 3.07 | = | 0 | (263) |
| Energy for water heating | (219) x | | 1.22 | = | 2509.03 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 5881.34 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | | 3.07 | = | 230.25 | (267) |
| Electricity for lighting | (232) x | | 0 | = | 1041.51 | (268) |
| Energy saving/generation technologies Item 1 | | | 3.07 | = | -2465.81 | (269) |
| 'Total Primary Energy | | sum of (265)…(271) = | | | 4687.29 | (272) |
| **Primary energy kWh/m²/year** | | (272) ÷ (4) = | | | 62.98 | (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 59

**Address :** Plot 59, 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

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/( 1.4 )+ 0.04] | | = | 2.15 | | | (27) |
| Windows Type 2 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 3 | | | 1.1 | x1/[1/( 1.4 )+ 0.04] | | = | 1.46 | | | (27) |
| Windows Type 4 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 5 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 6 | | | 3.78 | x1/[1/( 1.4 )+ 0.04] | | = | 5.01 | | | (27) |
| Floor | | | 37.21 | x | 0.13 | = | 4.8373 | | | (28) |
| Walls | 86.71 | 12.16 | 74.55 | x | 0.18 | = | 13.42 | | | (29) |
| Roof | 37.21 | 0 | 37.21 | x | 0.13 | = | 4.84 | | | (30) |
| Total area of elements, m² | | | 161.13 | | | | | | | (31) |
| Party wall | | | 80.48 | 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) = 38.95 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 11220.24 (34)

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

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f*

*can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K — 8.1 (36)

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

Total fabric heat loss (33) + (36) = 47.05 (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= | 86.25 | 85.92 | 85.6 | 84.09 | 83.81 | 82.5 | 82.5 | 82.25 | 83 | 83.81 | 84.38 | 84.98 | |

Average = Sum(39)$_{1...12}$ /12= 84.09 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.16 | 1.15 | 1.15 | 1.13 | 1.13 | 1.11 | 1.11 | 1.11 | 1.12 | 1.13 | 1.13 | 1.14 | |

Average = Sum(40)$_{1...12}$ /12= 1.13 (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= | 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)

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stag

STUDIO11 architecture

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= | 19.21 | 17.06 | 13.88 | 10.5 | 7.85 | 6.63 | 7.16 | 9.31 | 12.5 | 15.87 | 18.52 | 19.74 |

(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= | 326.75 | 325.42 | 314.05 | 295.39 | 275.73 | 257.38 | 245.85 | 249.58 | 259.51 | 278.31 | 299.92 | 316.81 |

(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

STUDIO11 architecture

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 1.62 | x | 36.79 | x | 0.63 | x | 0.7 | = | 18.22 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 62.67 | x | 0.63 | x | 0.7 | = | 31.03 | (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 | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 85.75 | x | 0.63 | x | 0.7 | = | 42.46 | (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 | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 106.25 | x | 0.63 | x | 0.7 | = | 52.6 | (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 | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 119.01 | x | 0.63 | x | 0.7 | = | 58.92 | (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 | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 118.15 | x | 0.63 | x | 0.7 | = | 58.5 | (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 | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 113.91 | x | 0.63 | x | 0.7 | = | 56.4 | (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 | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 104.39 | x | 0.63 | x | 0.7 | = | 51.68 | (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 | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 92.85 | x | 0.63 | x | 0.7 | = | 45.97 | (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 | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 69.27 | x | 0.63 | x | 0.7 | = | 34.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 44.07 | x | 0.63 | x | 0.7 | = | 21.82 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 31.49 | x | 0.63 | x | 0.7 | = | 15.59 | (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 | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | (81) |
| Northwest 0.9x | 0.77 | x | 3.78 | x | 11.28 | x | 0.63 | x | 0.7 | = | 13.03 | (81) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stag

STUDIO11 architecture

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 22.97 | x | 0.63 | x | 0.7 | = | 26.53 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 41.38 | x | 0.63 | x | 0.7 | = | 47.8 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 67.96 | x | 0.63 | x | 0.7 | = | 78.5 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 91.35 | x | 0.63 | x | 0.7 | = | 105.52 | | (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 | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 97.38 | x | 0.63 | x | 0.7 | = | 112.5 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 91.1 | x | 0.63 | x | 0.7 | = | 105.24 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 72.63 | x | 0.63 | x | 0.7 | = | 83.9 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 50.42 | x | 0.63 | x | 0.7 | = | 58.25 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 28.07 | x | 0.63 | x | 0.7 | = | 32.42 | | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 14.2 | x | 0.63 | x | 0.7 | = | 16.4 | | (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 | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 9.21 | x | 0.63 | x | 0.7 | = | 10.64 | | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 67.05 | 120.95 | 183.38 | 257.2 | 315.45 | 325.21 | 308.53 | 263.23 | 208.65 | 138.5 | 81.54 | 56.59 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 393.8 | 446.37 | 497.43 | 552.59 | 591.18 | 582.59 | 554.38 | 512.81 | 468.17 | 416.81 | 381.46 | 373.4 | (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 |
|---|---|---|---|---|---|---|---|---|---|---|---|

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stag

STUDIO11 architecture

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.98 | 0.93 | 0.79 | 0.63 | 0.69 | 0.91 | 0.99 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.68 | 19.82 | 20.06 | 20.4 | 20.71 | 20.92 | 20.98 | 20.97 | 20.81 | 20.42 | 20 | 19.67 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.95 | 19.96 | 19.96 | 19.98 | 19.98 | 19.99 | 19.99 | 20 | 19.99 | 19.98 | 19.97 | 19.97 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.97 | 0.9 | 0.71 | 0.5 | 0.56 | 0.85 | 0.98 | 1 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.75 | 18.89 | 19.13 | 19.48 | 19.77 | 19.95 | 19.99 | 19.99 | 19.88 | 19.5 | 19.08 | 18.74 | (90) |

fLA = Living area ÷ (4) = 0.27 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19 | 19.13 | 19.38 | 19.72 | 20.02 | 20.21 | 20.25 | 20.25 | 20.13 | 19.75 | 19.32 | 18.99 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19 | 19.13 | 19.38 | 19.72 | 20.02 | 20.21 | 20.25 | 20.25 | 20.13 | 19.75 | 19.32 | 18.99 | (93) |

## 8. Space heating requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 1 | 0.99 | 0.97 | 0.9 | 0.73 | 0.53 | 0.6 | 0.86 | 0.98 | 1 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 393.01 | 444.55 | 492.38 | 534.66 | 530.3 | 424.73 | 295.4 | 306.16 | 404.41 | 408.15 | 379.93 | 372.83 | (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= | 1267.61 | 1223.12 | 1102.27 | 910.03 | 697.39 | 462.84 | 301.41 | 316.62 | 500.19 | 766.53 | 1031.54 | 1256.94 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 650.71 | 523.2 | 453.75 | 270.26 | 124.31 | 0 | 0 | 0 | 0 | 266.64 | 469.16 | 657.78 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3415.81 (98)

Space heating requirement in kWh/m²/year 45.9 (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 | 775.46 | 610.47 | 625.12 | 0 | 0 | 0 | 0 | (100) |
| Utilisation factor for loss hm | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.83 | 0.9 | 0.88 | 0 | 0 | 0 | 0 | (101) |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 646.98 | 552.18 | 547.05 | 0 | 0 | 0 | 0 | (102) |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 768.54 | 733.81 | 686.75 | 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 | 87.53 | 135.13 | 103.94 | 0 | 0 | 0 | 0 | |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stag

STUDIO11 architecture

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

Intermittency factor (Table 10b)

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

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

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (107)m= | 0 | 0 | 0 | 0 | 0 | 21.88 | 33.78 | 25.98 | 0 | 0 | 0 | 0 |

| | | | |
|---|---|---|---|
| | Total = Sum(107) = | 81.65 | (107) |
| Space cooling requirement in kWh/m²/year | (107) ÷ (4) = | 1.1 | (108) |

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

| | | | |
|---|---|---|---|
| Fabric Energy Efficiency | (99) + (108) = | 47 | (109) |
| **Target Fabric Energy Efficiency (TFEE)** | | 54.05 | (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 59

**Address :** Plot 59, 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 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 3 | | | 1.1 | x1/[1/( 1.2 )+ 0.04] | | = | 1.26 | | | (27) |
| Windows Type 4 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 5 | | | 0.66 | x1/[1/( 1.2 )+ 0.04] | | = | 0.76 | | | (27) |
| Windows Type 6 | | | 3.78 | x1/[1/( 1.2 )+ 0.04] | | = | 4.33 | | | (27) |
| Floor | | | 37.21 | x | 0.12 | = | 4.4652 | | | (28) |
| Walls | 86.71 | 12.16 | 74.55 | x | 0.24 | = | 17.89 | | | (29) |
| Roof | 37.21 | 0 | 37.21 | x | 0.09 | = | 3.35 | | | (30) |
| Total area of elements, m² | | | 161.13 | | | | | | | (31) |
| Party wall | | | 80.48 | 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) = 39.75 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 11220.24 (34)

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

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f*

*can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K — 9.06 (36)

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

Total fabric heat loss (33) + (36) = 48.8 (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= | 88.01 | 87.68 | 87.36 | 85.85 | 85.57 | 84.25 | 84.25 | 84.01 | 84.76 | 85.57 | 86.14 | 86.73 | |

Average = Sum(39)$_{1...12}$ /12= 85.85 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.18 | 1.18 | 1.17 | 1.15 | 1.15 | 1.13 | 1.13 | 1.13 | 1.14 | 1.15 | 1.16 | 1.17 | |

Average = Sum(40)$_{1...12}$ /12= 1.15 (40)

Number of days in month (Table 1a)

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

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

Assumed occupancy, N — 2.35 (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)

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design sta

STUDIO11 architecture

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= | 19.21 | 17.06 | 13.88 | 10.5 | 7.85 | 6.63 | 7.16 | 9.31 | 12.5 | 15.87 | 18.52 | 19.74 | (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= | 326.75 | 325.42 | 314.05 | 295.39 | 275.73 | 257.38 | 245.85 | 249.58 | 259.51 | 278.31 | 299.92 | 316.81 | (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

STUDIO11 architecture

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 1.62 | x | 36.79 | x | 0.63 | x | 0.7 | = | 18.22 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 62.67 | x | 0.63 | x | 0.7 | = | 31.03 | (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 | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 85.75 | x | 0.63 | x | 0.7 | = | 42.46 | (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 | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 106.25 | x | 0.63 | x | 0.7 | = | 52.6 | (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 | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 119.01 | x | 0.63 | x | 0.7 | = | 58.92 | (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 | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 118.15 | x | 0.63 | x | 0.7 | = | 58.5 | (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 | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 113.91 | x | 0.63 | x | 0.7 | = | 56.4 | (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 | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 104.39 | x | 0.63 | x | 0.7 | = | 51.68 | (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 | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 92.85 | x | 0.63 | x | 0.7 | = | 45.97 | (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 | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 69.27 | x | 0.63 | x | 0.7 | = | 34.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 44.07 | x | 0.63 | x | 0.7 | = | 21.82 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 31.49 | x | 0.63 | x | 0.7 | = | 15.59 | (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 | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | (81) |
| Northwest 0.9x | 0.77 | x | 3.78 | x | 11.28 | x | 0.63 | x | 0.7 | = | 13.03 | (81) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design sta

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 22.97 | x | 0.63 | x | 0.7 | = | 26.53 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 41.38 | x | 0.63 | x | 0.7 | = | 47.8 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 67.96 | x | 0.63 | x | 0.7 | = | 78.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 91.35 | x | 0.63 | x | 0.7 | = | 105.52 | (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 | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 97.38 | x | 0.63 | x | 0.7 | = | 112.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 91.1 | x | 0.63 | x | 0.7 | = | 105.24 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 72.63 | x | 0.63 | x | 0.7 | = | 83.9 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 50.42 | x | 0.63 | x | 0.7 | = | 58.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 28.07 | x | 0.63 | x | 0.7 | = | 32.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 14.2 | x | 0.63 | x | 0.7 | = | 16.4 | (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 | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 9.21 | x | 0.63 | x | 0.7 | = | 10.64 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 67.05 | 120.95 | 183.38 | 257.2 | 315.45 | 325.21 | 308.53 | 263.23 | 208.65 | 138.5 | 81.54 | 56.59 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 393.8 | 446.37 | 497.43 | 552.59 | 591.18 | 582.59 | 554.38 | 512.81 | 468.17 | 416.81 | 381.46 | 373.4 | (84) |

## 7. Mean internal temperature (heating season)

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.98 | 0.93 | 0.8 | 0.64 | 0.7 | 0.91 | 0.99 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.65 | 19.79 | 20.03 | 20.37 | 20.69 | 20.91 | 20.98 | 20.97 | 20.8 | 20.4 | 19.97 | 19.64 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.93 | 19.94 | 19.94 | 19.96 | 19.96 | 19.97 | 19.97 | 19.98 | 19.97 | 19.96 | 19.95 | 19.95 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.97 | 0.9 | 0.72 | 0.5 | 0.57 | 0.86 | 0.98 | 1 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.7 | 18.84 | 19.09 | 19.44 | 19.74 | 19.93 | 19.97 | 19.97 | 19.85 | 19.47 | 19.04 | 18.7 | (90) |

fLA = Living area ÷ (4) = 0.27 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.95 | 19.09 | 19.34 | 19.69 | 19.99 | 20.19 | 20.24 | 20.23 | 20.1 | 19.71 | 19.29 | 18.95 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.95 | 19.09 | 19.34 | 19.69 | 19.99 | 20.19 | 20.24 | 20.23 | 20.1 | 19.71 | 19.29 | 18.95 | (93) |

## 8. Space heating requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 1 | 0.99 | 0.97 | 0.9 | 0.74 | 0.54 | 0.6 | 0.87 | 0.98 | 1 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 392.99 | 444.54 | 492.42 | 535.06 | 532.12 | 428.92 | 299.62 | 310.17 | 406.29 | 408.29 | 379.92 | 372.82 | (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= | 1289.7 | 1244.47 | 1121.47 | 926.03 | 709.6 | 471.05 | 306.53 | 322.03 | 508.81 | 779.89 | 1049.76 | 1279.21 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 667.15 | 537.55 | 468.01 | 281.5 | 132.04 | 0 | 0 | 0 | 0 | 276.47 | 482.29 | 674.36 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3519.37 (98)

Space heating requirement in kWh/m²/year 47.29 (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 | 791.96 | 623.46 | 638.46 | 0 | 0 | 0 | 0 | (100) |
| Utilisation factor for loss hm | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.82 | 0.9 | 0.86 | 0 | 0 | 0 | 0 | (101) |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 651.77 | 558.46 | 552.27 | 0 | 0 | 0 | 0 | (102) |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 768.54 | 733.81 | 686.75 | 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 | 84.07 | 130.46 | 100.06 | 0 | 0 | 0 | 0 | |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design sta

STUDIO11 architecture

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

Intermittency factor (Table 10b)

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

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

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (107)m= | 0 | 0 | 0 | 0 | 0 | 21.02 | 32.62 | 25.01 | 0 | 0 | 0 | 0 |

Total = Sum(107) = 78.65 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.06 (108)

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

Fabric Energy Efficiency — (99) + (108) = 48.35 (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 59

**Address :** Plot 59, 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 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 3 | | | 1.1 | x1/[1/( 1.2 )+ 0.04] | | = | 1.26 | | | (27) |
| Windows Type 4 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 5 | | | 0.66 | x1/[1/( 1.2 )+ 0.04] | | = | 0.76 | | | (27) |
| Windows Type 6 | | | 3.78 | x1/[1/( 1.2 )+ 0.04] | | = | 4.33 | | | (27) |
| Floor | | | 37.21 | x | 0.12 | = | 4.4652 | | | (28) |
| Walls | 86.71 | 12.16 | 74.55 | x | 0.24 | = | 17.89 | | | (29) |
| Roof | 37.21 | 0 | 37.21 | x | 0.09 | = | 3.35 | | | (30) |
| Total area of elements, m² | | | 161.13 | | | | | | | (31) |
| Party wall | | | 80.48 | 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) = 39.75 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 11220.24 (34)

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

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f*

# DER WorkSheet: New dwelling design stage

STUDIO11 architecture

*can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K — 9.06 (36)

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

Total fabric heat loss (33) + (36) = 48.8 (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= | 88.01 | 87.68 | 87.36 | 85.85 | 85.57 | 84.25 | 84.25 | 84.01 | 84.76 | 85.57 | 86.14 | 86.73 | |

Average = Sum(39)$_{1...12}$ /12= 85.85 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.18 | 1.18 | 1.17 | 1.15 | 1.15 | 1.13 | 1.13 | 1.13 | 1.14 | 1.15 | 1.16 | 1.17 | |

Average = Sum(40)$_{1...12}$ /12= 1.15 (40)

Number of days in month (Table 1a)

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

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

Assumed occupancy, N — 2.35 (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)

# DER WorkSheet: New dwelling design stage

STUDIO11 architecture

| | | |
|---|---|---|
| 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= | 19.21 | 17.06 | 13.88 | 10.5 | 7.85 | 6.63 | 7.16 | 9.31 | 12.5 | 15.87 | 18.52 | 19.74 | (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= | 364.91 | 362.83 | 349.9 | 329.11 | 308.07 | 287.79 | 274.61 | 280.45 | 291.14 | 312.13 | 336.22 | 354.22 | (73) |

## 6. Solar gains:

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

# DER WorkSheet: New dwelling design stage

STUDIO11 architecture

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 1.62 | x | 36.79 | x | 0.63 | x | 0.7 | = | 18.22 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 62.67 | x | 0.63 | x | 0.7 | = | 31.03 | (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 | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 85.75 | x | 0.63 | x | 0.7 | = | 42.46 | (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 | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 106.25 | x | 0.63 | x | 0.7 | = | 52.6 | (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 | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 119.01 | x | 0.63 | x | 0.7 | = | 58.92 | (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 | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 118.15 | x | 0.63 | x | 0.7 | = | 58.5 | (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 | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 113.91 | x | 0.63 | x | 0.7 | = | 56.4 | (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 | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 104.39 | x | 0.63 | x | 0.7 | = | 51.68 | (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 | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 92.85 | x | 0.63 | x | 0.7 | = | 45.97 | (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 | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 69.27 | x | 0.63 | x | 0.7 | = | 34.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 44.07 | x | 0.63 | x | 0.7 | = | 21.82 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 31.49 | x | 0.63 | x | 0.7 | = | 15.59 | (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 | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | (81) |
| Northwest 0.9x | 0.77 | x | 3.78 | x | 11.28 | x | 0.63 | x | 0.7 | = | 13.03 | (81) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 22.97 | x | 0.63 | x | 0.7 | = | 26.53 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 41.38 | x | 0.63 | x | 0.7 | = | 47.8 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 67.96 | x | 0.63 | x | 0.7 | = | 78.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 91.35 | x | 0.63 | x | 0.7 | = | 105.52 | (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 | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 97.38 | x | 0.63 | x | 0.7 | = | 112.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 91.1 | x | 0.63 | x | 0.7 | = | 105.24 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 72.63 | x | 0.63 | x | 0.7 | = | 83.9 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 50.42 | x | 0.63 | x | 0.7 | = | 58.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 28.07 | x | 0.63 | x | 0.7 | = | 32.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 14.2 | x | 0.63 | x | 0.7 | = | 16.4 | (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 | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 9.21 | x | 0.63 | x | 0.7 | = | 10.64 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 67.05 | 120.95 | 183.38 | 257.2 | 315.45 | 325.21 | 308.53 | 263.23 | 208.65 | 138.5 | 81.54 | 56.59 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 431.96 | 483.78 | 533.28 | 586.31 | 623.53 | 613 | 583.14 | 543.68 | 499.79 | 450.63 | 417.76 | 410.81 | (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 |
|---|---|---|---|---|---|---|---|---|---|---|---|

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.97 | 0.92 | 0.78 | 0.61 | 0.67 | 0.89 | 0.98 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.7 | 19.83 | 20.07 | 20.41 | 20.72 | 20.92 | 20.98 | 20.97 | 20.82 | 20.44 | 20.02 | 19.68 | (87) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.93 | 19.94 | 19.94 | 19.96 | 19.96 | 19.97 | 19.97 | 19.98 | 19.97 | 19.96 | 19.95 | 19.95 | (88) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 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= | 18.2 | 18.4 | 18.75 | 19.25 | 19.67 | 19.92 | 19.97 | 19.96 | 19.82 | 19.29 | 18.68 | 18.19 | (90) |

| | | |
|---|---|---|
| fLA = Living area ÷ (4) = | 0.27 | (91) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.6 | 18.78 | 19.1 | 19.56 | 19.95 | 20.19 | 20.24 | 20.23 | 20.09 | 19.6 | 19.04 | 18.59 | (92) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.45 | 18.63 | 18.95 | 19.41 | 19.8 | 20.04 | 20.09 | 20.08 | 19.94 | 19.45 | 18.89 | 18.44 | (93) |

## 8. Space heating requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.98 | 0.96 | 0.87 | 0.7 | 0.5 | 0.55 | 0.83 | 0.97 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 430.41 | 480.53 | 525.15 | 560.73 | 545.5 | 426.39 | 289.37 | 301.69 | 415.27 | 436.57 | 414.84 | 409.65 | (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= | 1245.13 | 1203.98 | 1087.93 | 902.12 | 693.07 | 458.03 | 293.9 | 309.46 | 494.79 | 757.05 | 1015.14 | 1234.73 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 606.16 | 486.15 | 418.71 | 245.8 | 109.79 | 0 | 0 | 0 | 0 | 238.44 | 432.21 | 613.85 | |

| | | |
|---|---|---|
| Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 3151.11 | (98) |
| Space heating requirement in kWh/m²/year | 42.34 | (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) | | | | | | | | | | | | | |
| | 606.16 | 486.15 | 418.71 | 245.8 | 109.79 | 0 | 0 | 0 | 0 | 238.44 | 432.21 | 613.85 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 672.02 | 538.97 | 464.2 | 272.5 | 121.72 | 0 | 0 | 0 | 0 | 264.34 | 479.17 | 680.55 | |

Total (kWh/year) =Sum(211)$_{1...5,9...12}$ = [redacted] (211)

# DER WorkSheet: New dwelling design stage

STUDIO11 architecture

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= | 89.44 | 89.39 | 89.27 | 88.97 | 88.35 | 87 | 87 | 87 | 87 | 88.92 | 89.3 | 89.47 |

(217)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 202.32 | 178.15 | 186.67 | 166.96 | 164.07 | 147.88 | 141.08 | 156.11 | 156.25 | 173.28 | 183.62 | 197.09 |

Total = Sum(219a)$_{1...12}$ = 2053.49 (219)

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 3493.47 | |
| Water heating fuel used | | 2053.49 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | 339.25 | (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 | = | 754.59 | (261) |
| Space heating (secondary) | (215) x | | 0.519 | = | 0 | (263) |
| Water heating | (219) x | | 0.216 | = | 443.55 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 1198.14 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | | 0.519 | = | 176.07 | (268) |
| Energy saving/generation technologies Item 1 | | | 0.519 | = | -416.86 | (269) |
| Total CO2, kg/year | sum of (265)…(271) = | | | | 996.28 | (272) |
| **Dwelling CO2 Emission Rate** | (272) ÷ (4) = | | | | 13.39 | (273) |
| EI rating (section 14) | | | | | 89 | (274) |

# TER 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 59

**Address :** Plot 59, 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 |

# TER 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/( 1.4 )+ 0.04] | | = | 2.15 | | | (27) |
| Windows Type 2 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 3 | | | 1.1 | x1/[1/( 1.4 )+ 0.04] | | = | 1.46 | | | (27) |
| Windows Type 4 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 5 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 6 | | | 3.78 | x1/[1/( 1.4 )+ 0.04] | | = | 5.01 | | | (27) |
| Floor | | | 37.21 | x | 0.13 | = | 4.8373 | | | (28) |
| Walls | 86.71 | 12.16 | 74.55 | x | 0.18 | = | 13.42 | | | (29) |
| Roof | 37.21 | 0 | 37.21 | x | 0.13 | = | 4.84 | | | (30) |
| Total area of elements, m² | | | 161.13 | | | | | | | (31) |
| Party wall | | | 80.48 | 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) = 38.95 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 11220.24 (34)

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

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f*

# TER WorkSheet: New dwelling design stage

STUDIO11 architecture

*can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K — 8.1 (36)

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

Total fabric heat loss (33) + (36) = 47.05 (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= | 86.25 | 85.92 | 85.6 | 84.09 | 83.81 | 82.5 | 82.5 | 82.25 | 83 | 83.81 | 84.38 | 84.98 | |

Average = Sum(39)$_{1...12}$ /12= 84.09 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.16 | 1.15 | 1.15 | 1.13 | 1.13 | 1.11 | 1.11 | 1.11 | 1.12 | 1.13 | 1.13 | 1.14 | |

Average = Sum(40)$_{1...12}$ /12= 1.13 (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= | 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)

# TER WorkSheet: New dwelling design stage

STUDIO11 architecture

| | | | |
|---|---|---|---|
| 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= | 19.21 | 17.06 | 13.88 | 10.5 | 7.85 | 6.63 | 7.16 | 9.31 | 12.5 | 15.87 | 18.52 | 19.74 | (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= | 370.37 | 367.68 | 354.13 | 332.73 | 311.08 | 290.18 | 277.01 | 283.46 | 294.76 | 316.37 | 341.07 | 359.68 | (73) |

## 6. Solar gains:

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

# TER WorkSheet: New dwelling design stage

STUDIO11 architecture

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast 0.9x | 0.77 | x | 1.62 | x | 36.79 | x | 0.63 | x | 0.7 | = | 18.22 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 36.79 | x | 0.63 | x | 0.7 | = | 16.19 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 36.79 | x | 0.63 | x | 0.7 | = | 12.37 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 62.67 | x | 0.63 | x | 0.7 | = | 31.03 | (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 | 1.1 | x | 62.67 | x | 0.63 | x | 0.7 | = | 21.07 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 85.75 | x | 0.63 | x | 0.7 | = | 42.46 | (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 | 1.1 | x | 85.75 | x | 0.63 | x | 0.7 | = | 28.83 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 106.25 | x | 0.63 | x | 0.7 | = | 52.6 | (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 | 1.1 | x | 106.25 | x | 0.63 | x | 0.7 | = | 35.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 119.01 | x | 0.63 | x | 0.7 | = | 58.92 | (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 | 1.1 | x | 119.01 | x | 0.63 | x | 0.7 | = | 40.01 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 118.15 | x | 0.63 | x | 0.7 | = | 58.5 | (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 | 1.1 | x | 118.15 | x | 0.63 | x | 0.7 | = | 39.72 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 113.91 | x | 0.63 | x | 0.7 | = | 56.4 | (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 | 1.1 | x | 113.91 | x | 0.63 | x | 0.7 | = | 38.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 104.39 | x | 0.63 | x | 0.7 | = | 51.68 | (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 | 1.1 | x | 104.39 | x | 0.63 | x | 0.7 | = | 35.09 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 92.85 | x | 0.63 | x | 0.7 | = | 45.97 | (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 | 1.1 | x | 92.85 | x | 0.63 | x | 0.7 | = | 31.21 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 69.27 | x | 0.63 | x | 0.7 | = | 34.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 69.27 | x | 0.63 | x | 0.7 | = | 30.48 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 69.27 | x | 0.63 | x | 0.7 | = | 23.29 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 44.07 | x | 0.63 | x | 0.7 | = | 21.82 | (77) |
| Southeast 0.9x | 0.77 | x | 1.44 | x | 44.07 | x | 0.63 | x | 0.7 | = | 19.39 | (77) |
| Southeast 0.9x | 0.77 | x | 1.1 | x | 44.07 | x | 0.63 | x | 0.7 | = | 14.82 | (77) |
| Southeast 0.9x | 0.77 | x | 1.62 | x | 31.49 | x | 0.63 | x | 0.7 | = | 15.59 | (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 | 1.1 | x | 31.49 | x | 0.63 | x | 0.7 | = | 10.59 | (77) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.28 | (81) |
| Northwest 0.9x | 0.77 | x | 3.78 | x | 11.28 | x | 0.63 | x | 0.7 | = | 13.03 | (81) |

# TER WorkSheet: New dwelling design stage

STUDIO11 architecture

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 22.97 | x | 0.63 | x | 0.7 | = | 26.53 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.21 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 41.38 | x | 0.63 | x | 0.7 | = | 8.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 41.38 | x | 0.63 | x | 0.7 | = | 47.8 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.91 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 67.96 | x | 0.63 | x | 0.7 | = | 13.71 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 67.96 | x | 0.63 | x | 0.7 | = | 78.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.35 | x | 0.63 | x | 0.7 | = | 40.2 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.35 | x | 0.63 | x | 0.7 | = | 18.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 91.35 | x | 0.63 | x | 0.7 | = | 105.52 | (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 | 0.66 | x | 97.38 | x | 0.63 | x | 0.7 | = | 19.64 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 97.38 | x | 0.63 | x | 0.7 | = | 112.5 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 91.1 | x | 0.63 | x | 0.7 | = | 40.09 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 91.1 | x | 0.63 | x | 0.7 | = | 18.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 91.1 | x | 0.63 | x | 0.7 | = | 105.24 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 72.63 | x | 0.63 | x | 0.7 | = | 14.65 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 72.63 | x | 0.63 | x | 0.7 | = | 83.9 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.19 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 50.42 | x | 0.63 | x | 0.7 | = | 10.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 50.42 | x | 0.63 | x | 0.7 | = | 58.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 28.07 | x | 0.63 | x | 0.7 | = | 5.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 28.07 | x | 0.63 | x | 0.7 | = | 32.42 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.25 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 14.2 | x | 0.63 | x | 0.7 | = | 16.4 | (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 | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 3.78 | x | 9.21 | x | 0.63 | x | 0.7 | = | 10.64 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 67.05 | 120.95 | 183.38 | 257.2 | 315.45 | 325.21 | 308.53 | 263.23 | 208.65 | 138.5 | 81.54 | 56.59 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 437.42 | 488.63 | 537.51 | 589.93 | 626.54 | 615.39 | 585.53 | 546.69 | 503.41 | 454.87 | 422.61 | 416.27 | (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 |
|---|---|---|---|---|---|---|---|---|---|---|---|

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.97 | 0.91 | 0.77 | 0.6 | 0.66 | 0.89 | 0.98 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.74 | 19.87 | 20.11 | 20.44 | 20.74 | 20.93 | 20.98 | 20.98 | 20.84 | 20.46 | 20.05 | 19.72 | (87) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.95 | 19.96 | 19.96 | 19.98 | 19.98 | 19.99 | 19.99 | 20 | 19.99 | 19.98 | 19.97 | 19.97 | (88) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.96 | 0.88 | 0.68 | 0.47 | 0.53 | 0.82 | 0.97 | 0.99 | 1 | (89) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.27 | 18.47 | 18.81 | 19.3 | 19.71 | 19.94 | 19.99 | 19.99 | 19.85 | 19.34 | 18.74 | 18.26 | (90) |

fLA = Living area ÷ (4) = 0.27 (91)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.66 | 18.84 | 19.16 | 19.6 | 19.98 | 20.21 | 20.25 | 20.25 | 20.12 | 19.64 | 19.09 | 18.65 | (92) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.66 | 18.84 | 19.16 | 19.6 | 19.98 | 20.21 | 20.25 | 20.25 | 20.12 | 19.64 | 19.09 | 18.65 | (93) |

## 8. Space heating requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.98 | 0.96 | 0.88 | 0.7 | 0.51 | 0.56 | 0.83 | 0.97 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 435.85 | 485.37 | 529.4 | 564.4 | 548.92 | 430.95 | 296.65 | 308.57 | 419.82 | 440.85 | 419.68 | 415.11 | (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= | 1238.48 | 1197.81 | 1083.54 | 900.2 | 694.31 | 462.59 | 301.44 | 316.68 | 499.28 | 757.73 | 1011.63 | 1227.7 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 597.16 | 478.76 | 412.28 | 241.77 | 108.17 | 0 | 0 | 0 | 0 | 235.76 | 426.2 | 604.57 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3104.67 (98)

Space heating requirement in kWh/m²/year 41.72 (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) | | | | | | | | | | | | | |
| | 597.16 | 478.76 | 412.28 | 241.77 | 108.17 | 0 | 0 | 0 | 0 | 235.76 | 426.2 | 604.57 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 639.36 | 512.59 | 441.41 | 258.86 | 115.81 | 0 | 0 | 0 | 0 | 252.42 | 456.32 | 647.29 | |

Total (kWh/year) =Sum(211) = (211)

# TER WorkSheet: New dwelling design stage

STUDIO11 architecture

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= | 87.66 | 87.49 | 87.08 | 86.1 | 84.18 | 80.3 | 80.3 | 80.3 | 80.3 | 85.92 | 87.17 | 87.73 |

(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 224.97 | 196.91 | 205.83 | 184.63 | 182.83 | 168.82 | 161.74 | 180.3 | 182.29 | 193.99 | 204.12 | 219.5 |

Total = Sum(219a)$_{1...12}$ = 2305.92 (219)

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 3324.05 | |
| Water heating fuel used | | 2305.92 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | 75 | (231) |
| Electricity for lighting | | 339.25 | (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 | = | 718 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 498.08 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1216.07 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 176.07 | (268) |
| Total CO2, kg/year | sum of (265)…(271) = | | | 1431.07 | (272) |

**TER =** 19.23 (273)

# SAP 2012 Overheating Assessment

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

STUDIO11 architecture

## Property Details: Plot 59

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

## Overheating Details:

| | | |
|---|---|---|
| **Summer ventilation heat loss coefficient:** | 184.56 | **(P1)** |
| **Transmission heat loss coefficient:** | 48.8 | |
| **Summer heat loss coefficient:** | 233.36 | **(P2)** |

## Overhangs:

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

## Solar shading:

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

## Solar gains:

| Orientation | | Area | Flux | g_ | FF | Shading | Gains | |
|---|---|---|---|---|---|---|---|---|
| South East (W1 ) | 0.9 x | 1.62 | 113.91 | 0.63 | 0.7 | 0.9 | 65.92 | |
| South East (W3) | 0.9 x | 1.44 | 113.91 | 0.63 | 0.7 | 0.9 | 58.59 | |
| South East (W4) | 0.9 x | 1.1 | 113.91 | 0.63 | 0.7 | 0.9 | 44.76 | |
| North West (W5) | 0.9 x | 1.44 | 91.1 | 0.63 | 0.7 | 0.9 | 46.86 | |
| North West (W6) | 0.9 x | 0.66 | 91.1 | 0.63 | 0.7 | 0.9 | 21.48 | |
| North West (D2) | 0.9 x | 3.78 | 91.1 | 0.63 | 0.7 | 0.9 | 123.01 | |
| | | | | | | **Total** | 360.62 | **(P3/P4)** |

## Internal gains:

| | June | July | August | |
|---|---|---|---|---|
| Internal gains | 415.84 | 398.95 | 406.95 | |
| Total summer gains | 795.95 | 759.57 | 714.62 | **(P5)** |

# SAP 2012 Overheating Assessment

| | | | | |
|---|---|---|---|---|
| Summer gain/loss ratio | 3.41 | 3.25 | 3.06 | **(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 | 18.26 | 20.1 | 19.71 | **(P7)** |
| **Likelihood of high internal temperature** | **Not significant** | **Not significant** | **Not significant** | |

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