# 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 2:21:51 PM*

## Project Information:

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

## Dwelling Details:

**NEW DWELLING DESIGN STAGE** Total Floor Area: 145.6m²
**Site Reference :** Wardentree Lane **Plot Reference:** Plot 8
**Address :** Plot 8 , 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) | 16.16 kg/m² | |
| Dwelling Carbon Dioxide Emission Rate (DER) | 13.72 kg/m² | **OK** |

## 1b TFEE and DFEE

| | | |
|---|---|---|
| Target Fabric Energy Efficiency (TFEE) | 57.6 kWh/m² | |
| Dwelling Fabric Energy Efficiency (DFEE) | 55.9 kWh/m² | |
| | | **OK** |

## 2 Fabric U-values

| Element | Average | Highest | |
|---|---|---|---|
| External wall | 0.24 (max. 0.30) | 0.24 (max. 0.70) | **OK** |
| Floor | 0.12 (max. 0.25) | 0.12 (max. 0.70) | **OK** |
| Roof | 0.09 (max. 0.20) | 0.09 (max. 0.35) | **OK** |
| Openings | 1.20 (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 010320):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Vaillant
Model: Ecotec Plus
Model qualifier: 612
(Regular)
Efficiency 89.0 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: None

# Regulations Compliance Report

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## 5 Cylinder insulation

| | | |
|---|---|---|
| Hot water Storage: | Measured cylinder loss: 2.08 kWh/day | |
| | Permitted by DBSCG: 2.30 kWh/day | OK |
| Primary pipework insulated: | Yes | OK |

## 6 Controls

| | | |
|---|---|---|
| Space heating controls | TTZC by plumbing and electrical services | OK |
| Hot water controls: | Cylinderstat | OK |
| | Independent timer for DHW | OK |
| 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 | 2.39m² |
| Windows facing: South East | 0.48m² |
| Windows facing: South East | 0.48m² |
| Windows facing: South West | 1.62m² |
| Windows facing: North East | 0.76m² |
| Windows facing: North East | 0.76m² |
| Windows facing: South East | 2.12m² |
| Windows facing: South East | 0.51m² |
| Windows facing: South East | 0.51m² |
| Windows facing: South East | 2.12m² |
| Windows facing: South West | 1.44m² |
| Windows facing: North West | 1.44m² |
| Windows facing: North West | 0.66m² |
| Windows facing: North West | 0.51m² |
| Windows facing: North West | 1.44m² |
| Windows facing: North West | 5.04m² |
| Windows facing: North West | 5.04m² |
| Ventilation rate: | 3.00 |
| Blinds/curtains: | |
| | Closed 100% of daylight hours |

## 10 Key features

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

# SAP Input

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## Property Details: Plot 8

| | |
|---|---|
| Address: | Plot 8 , 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: | Detached |
| Year Completed: | 2016 |

| Floor Location: | Floor area: | Storey height: |
|---|---|---|
| Basement floor | 72.8 m² | 2.4 m |
| Floor 1 | 72.8 m² | 2.6 m |

| | |
|---|---|
| Living area: | 26.81 m² (fraction 0.184) |
| 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 |
| Side Door | Manufacturer | Half glazed | low-E, En = 0.05, soft coat | Yes | PVC-U |
| W1 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W2 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W3 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W5 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W6 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W7 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W8 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W9 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W10 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W11 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W12 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W13 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W14 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W15 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W16 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| D3 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| D4 | 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 |
| Side Door | 16mm or more mm | 0.7 | 0.63 | 1.2 | 1.97 | 1 |
| W1 | 16mm or more | 0.7 | 0.63 | 1.2 | 2.39 | 1 |
| W2 | 16mm or more | 0.7 | 0.63 | 1.2 | 0.48 | 1 |
| W3 | 16mm or more | 0.7 | 0.63 | 1.2 | 0.48 | 1 |
| W5 | 16mm or more | 0.7 | 0.63 | 1.2 | 1.62 | 1 |
| W6 | 16mm or more | 0.7 | 0.63 | 1.2 | 0.76 | 1 |

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| | | | | | | |
|---|---|---|---|---|---|---|
| W7 | 16mm or more | 0.7 | 0.63 | 1.2 | 0.76 | 1 |
| W8 | 16mm or more | 0.7 | 0.63 | 1.2 | 2.12 | 1 |
| W9 | 16mm or more | 0.7 | 0.63 | 1.2 | 0.51 | 1 |
| W10 | 16mm or more | 0.7 | 0.63 | 1.2 | 0.51 | 1 |
| W11 | 16mm or more | 0.7 | 0.63 | 1.2 | 2.12 | 1 |
| W12 | 16mm or more | 0.7 | 0.63 | 1.2 | 1.44 | 1 |
| W13 | 16mm or more | 0.7 | 0.63 | 1.2 | 1.44 | 1 |
| W14 | 16mm or more | 0.7 | 0.63 | 1.2 | 0.66 | 1 |
| W15 | 16mm or more | 0.7 | 0.63 | 1.2 | 0.51 | 1 |
| W16 | 16mm or more | 0.7 | 0.63 | 1.2 | 1.44 | 1 |
| D3 | 16mm or more | 0.7 | 0.63 | 1.2 | 5.04 | 1 |
| D4 | 16mm or more | 0.7 | 0.63 | 1.2 | 5.04 | 1 |

| Name: | Type-Name: | Location: | Orient: | Width: | Height: |
|---|---|---|---|---|---|
| Front Door | | External Wall | South East | 1.01 | 2.1 |
| Side Door | | External Wall | North West | 0.94 | 2.1 |
| W1 | | External Wall | South East | 1.77 | 1.35 |
| W2 | | External Wall | South East | 0.4 | 1.2 |
| W3 | | External Wall | South East | 0.4 | 1.2 |
| W5 | | External Wall | South West | 1.2 | 1.35 |
| W6 | | External Wall | North East | 0.63 | 1.2 |
| W7 | | External Wall | North East | 0.63 | 1.2 |
| W8 | | External Wall | South East | 1.77 | 1.2 |
| W9 | | External Wall | South East | 0.488 | 1.05 |
| W10 | | External Wall | South East | 0.488 | 1.05 |
| W11 | | External Wall | South East | 1.77 | 1.2 |
| W12 | | External Wall | South West | 1.2 | 1.2 |
| W13 | | External Wall | North West | 1.2 | 1.2 |
| W14 | | External Wall | North West | 0.63 | 1.05 |
| W15 | | External Wall | North West | 0.488 | 1.05 |
| W16 | | External Wall | North West | 1.2 | 1.2 |
| D3 | | External Wall | North West | 2.4 | 2.1 |
| D4 | | External Wall | North West | 2.4 | 2.1 |

Overshading: Average or unknown

## Opaque Elements:

| Type: | Gross area: | Openings: | Net area: | U-value: | Ru value: | Curtain wall: | Kappa: |
|---|---|---|---|---|---|---|---|
| External Elements | | | | | | | |
| External Wall | 173.35 | 31.41 | 141.94 | 0.24 | 0 | False | N/A |
| Main Roof | 72.8 | 0 | 72.8 | 0.09 | 0 | | N/A |
| Ground Floor | 72.8 | | | 0.12 | | | N/A |
| Internal Elements | | | | | | | |
| Party Elements | | | | | | | |

## Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0915

| | Length | Psi-value | | |
|---|---|---|---|---|
| [Approved] | 22.78 | 0.5 | E1 | Steel lintel with perforated steel base plate |
| [Approved] | 16.03 | 0.04 | E3 | Sill |
| [Approved] | 54.3 | 0.05 | E4 | Jamb |
| [Approved] | 34.67 | 0.16 | E5 | Ground floor (normal) |
| [Approved] | 20.37 | 0.06 | E10 | Eaves (insulation at ceiling level) |
| [Approved] | 14.3 | 0.24 | E12 | Gable (insulation at ceiling level) |
| [Approved] | 20 | 0.09 | E16 | Corner (normal) |
| [Approved] | 34.67 | 0.07 | E6 | Intermediate floor within a dwelling |

# SAP Input

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## Ventilation:

| | |
|---|---|
| Pressure test: | Yes (As designed) |
| Ventilation: | Natural ventilation (extract fans) |
| Number of chimneys: | 0 |
| Number of open flues: | 0 |
| Number of fans: | 6 |
| 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 010320) Efficiency: Winter 79.3 % Summer: 90.0
Brand name: Vaillant
Model: Ecotec Plus
Model qualifier: 612
(Regular 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
Hot water cylinder
Cylinder volume: 210 litres
Cylinder insulation: Factory 75 mm
Primary pipework insulation: True
Cylinderstat: True
Cylinder in heated space: True
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: 1.5<br>Tilt of collector: 45°<br>Overshading: None or very little<br>Collector Orientation: South East |
| Assess Zero Carbon Home: | No |

# SAP WorkSheet: New dwelling design stage

STUDIO11 architecture

## User Details:

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

## Property Address: Plot 8

**Address :** Plot 8 , Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 72.8 (1a) | x | 2.4 (2a) | = | 174.72 | (3a) |
| Ground floor | 72.8 (1b) | x | 2.6 (2b) | = | 189.28 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 145.6 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 364 | (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 | | | | | | | 6 | x 10 = | 60 | (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) = | 60 | ÷ (5) = | 0.16 (8) |

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

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | | 0 (9) |
| Additional infiltration | | [(9)-1]x0.1 = | 0 (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | | 0 (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | | 0 (12) |
| If no draught lobby, enter 0.05, else enter 0 | | | 0 (13) |
| Percentage of windows and doors draught stripped | | | 0 (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | | 0 (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | | 0 (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | | 5 (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | 0.41 (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 1 (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | | 0.41 (21) |

Infiltration rate modified for monthly wind speed

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.53 | 0.52 | 0.51 | 0.46 | 0.45 | 0.39 | 0.39 | 0.38 | 0.41 | 0.45 | 0.47 | 0.49 |

*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 | 0.59 | 0.6 | 0.61 | 0.62 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.64 | 0.63 | 0.63 | 0.6 | 0.6 | 0.58 | 0.58 | 0.57 | 0.59 | 0.6 | 0.61 | 0.62 |

(25)

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors Type 1 | | | 2.12 | x | 1.2 | = | 2.544 | | | (26) |
| Doors Type 2 | | | 1.97 | x | 1.2 | = | 2.364 | | | (26) |
| Windows Type 1 | | | 2.39 | x1/[1/( 1.2 )+ 0.04] | | = | 2.74 | | | (27) |
| Windows Type 2 | | | 0.48 | x1/[1/( 1.2 )+ 0.04] | | = | 0.55 | | | (27) |
| Windows Type 3 | | | 0.48 | x1/[1/( 1.2 )+ 0.04] | | = | 0.55 | | | (27) |
| Windows Type 4 | | | 1.62 | x1/[1/( 1.2 )+ 0.04] | | = | 1.85 | | | (27) |
| Windows Type 5 | | | 0.76 | x1/[1/( 1.2 )+ 0.04] | | = | 0.87 | | | (27) |
| Windows Type 6 | | | 0.76 | x1/[1/( 1.2 )+ 0.04] | | = | 0.87 | | | (27) |
| Windows Type 7 | | | 2.12 | x1/[1/( 1.2 )+ 0.04] | | = | 2.43 | | | (27) |
| Windows Type 8 | | | 0.51 | x1/[1/( 1.2 )+ 0.04] | | = | 0.58 | | | (27) |
| Windows Type 9 | | | 0.51 | x1/[1/( 1.2 )+ 0.04] | | = | 0.58 | | | (27) |
| Windows Type 10 | | | 2.12 | x1/[1/( 1.2 )+ 0.04] | | = | 2.43 | | | (27) |
| Windows Type 11 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 12 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 13 | | | 0.66 | x1/[1/( 1.2 )+ 0.04] | | = | 0.76 | | | (27) |
| Windows Type 14 | | | 0.51 | x1/[1/( 1.2 )+ 0.04] | | = | 0.58 | | | (27) |
| Windows Type 15 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 16 | | | 5.04 | x1/[1/( 1.2 )+ 0.04] = | 5.77 | | | | (27) |
| Windows Type 17 | | | 5.04 | x1/[1/( 1.2 )+ 0.04] = | 5.77 | | | | (27) |
| Floor | | | 72.8 | x 0.12 = | 8.736 | | | | (28) |
| Walls | 173.35 | 31.41 | 141.94 | x 0.24 = | 34.07 | | | | (29) |
| Roof | 72.8 | 0 | 72.8 | x 0.09 = | 6.55 | | | | (30) |
| Total area of elements, m² | | | 318.95 | | | | | | (31) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 85.54 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 14631.6 (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 29.17 (36)

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

Total fabric heat loss (33) + (36) = 114.72 (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= | 76.86 | 76.21 | 75.57 | 72.57 | 72 | 69.39 | 69.39 | 68.9 | 70.4 | 72 | 73.14 | 74.33 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 191.58 | 190.93 | 190.29 | 187.28 | 186.72 | 184.11 | 184.11 | 183.62 | 185.11 | 186.72 | 187.86 | 189.05 | |

Average = Sum(39)$_{1...12}$ /12= 187.28 (39)

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

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

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

Number of days in month (Table 1a)

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

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

Assumed occupancy, N 2.93 (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) + 36 103.72 (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= | 114.09 | 109.94 | 105.79 | 101.64 | 97.49 | 93.35 | 93.35 | 97.49 | 101.64 | 105.79 | 109.94 | 114.09 | |

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

Total = Sum(44)$_{1...12}$ = 1244.62 (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= | 169.19 | 147.98 | 152.7 | 133.13 | 127.74 | 110.23 | 102.14 | 117.21 | 118.61 | 138.23 | 150.89 | 163.85 | |

Total = Sum(45)$_{1...12}$ = 1631.89 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25.38 | 22.2 | 22.9 | 19.97 | 19.16 | 16.53 | 15.32 | 17.58 | 17.79 | 20.73 | 22.63 | 24.58 | (46) |

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Water storage loss:

| | | | |
|---|---|---|---|
| Storage volume (litres) including any solar or WWHRS storage within same vessel | | 210 | (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) = | 210 | (50) |
| b) If manufacturer's declared cylinder loss factor is not known: | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | 0.01 | (51) |
| If community heating see section 4.3 | | | |
| Volume factor from Table 2a | | 0.83 | (52) |
| Temperature factor from Table 2b | | 0.54 | (53) |
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 1.13 | (54) |
| Enter (50) or (54) in (55) | | 1.13 | (55) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 34.9 | 31.52 | 34.9 | 33.77 | 34.9 | 33.77 | 34.9 | 34.9 | 33.77 | 34.9 | 33.77 | 34.9 | (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= | 34.9 | 31.52 | 34.9 | 33.77 | 34.9 | 33.77 | 34.9 | 34.9 | 33.77 | 34.9 | 33.77 | 34.9 | (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= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (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= | 227.35 | 200.51 | 210.86 | 189.41 | 185.9 | 166.51 | 160.3 | 175.37 | 174.89 | 196.39 | 207.17 | 222.01 | (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= | 227.35 | 200.51 | 210.86 | 189.41 | 185.9 | 166.51 | 160.3 | 175.37 | 174.89 | 196.39 | 207.17 | 222.01 | |

| | | |
|---|---|---|
| Output from water heater (annual)$_{1...12}$ | 2316.65 | (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= | 102.78 | 91.23 | 97.3 | 89.29 | 89 | 81.68 | 80.49 | 85.5 | 84.46 | 92.49 | 95.2 | 101.01 | (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= | 175.62 | 175.62 | 175.62 | 175.62 | 175.62 | 175.62 | 175.62 | 175.62 | 175.62 | 175.62 | 175.62 | 175.62 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 70.44 | 62.56 | 50.88 | 38.52 | 28.79 | 24.31 | 26.27 | 34.14 | 45.83 | 58.19 | 67.91 | 72.4 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 471.19 | 476.07 | 463.75 | 437.52 | 404.41 | 373.29 | 352.5 | 347.61 | 359.93 | 386.16 | 419.28 | 450.4 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 55.49 | 55.49 | 55.49 | 55.49 | 55.49 | 55.49 | 55.49 | 55.49 | 55.49 | 55.49 | 55.49 | 55.49 | (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= | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 138.15 | 135.75 | 130.78 | 124.01 | 119.62 | 113.44 | 108.18 | 114.92 | 117.31 | 124.31 | 132.22 | 135.76 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 796.81 | 791.42 | 762.44 | 717.09 | 669.86 | 628.07 | 603.98 | 613.7 | 640.1 | 685.69 | 736.44 | 775.59 | (73) |

## 6. Solar gains:

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

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast 0.9x | 0.77 | x | 0.76 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 22.97 | x | 0.63 | x | 0.7 | = | 5.33 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 22.97 | x | 0.63 | x | 0.7 | = | 5.33 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 41.38 | x | 0.63 | x | 0.7 | = | 9.61 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 41.38 | x | 0.63 | x | 0.7 | = | 9.61 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 67.96 | x | 0.63 | x | 0.7 | = | 15.78 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 67.96 | x | 0.63 | x | 0.7 | = | 15.78 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.35 | x | 0.63 | x | 0.7 | = | 21.22 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.35 | x | 0.63 | x | 0.7 | = | 21.22 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 97.38 | x | 0.63 | x | 0.7 | = | 22.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 97.38 | x | 0.63 | x | 0.7 | = | 22.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.1 | x | 0.63 | x | 0.7 | = | 21.16 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.1 | x | 0.63 | x | 0.7 | = | 21.16 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 72.63 | x | 0.63 | x | 0.7 | = | 16.87 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 72.63 | x | 0.63 | x | 0.7 | = | 16.87 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 50.42 | x | 0.63 | x | 0.7 | = | 11.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 50.42 | x | 0.63 | x | 0.7 | = | 11.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 28.07 | x | 0.63 | x | 0.7 | = | 6.52 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 28.07 | x | 0.63 | x | 0.7 | = | 6.52 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 14.2 | x | 0.63 | x | 0.7 | = | 3.3 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 14.2 | x | 0.63 | x | 0.7 | = | 3.3 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 9.21 | x | 0.63 | x | 0.7 | = | 2.14 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 9.21 | x | 0.63 | x | 0.7 | = | 2.14 | (75) |
| Southeast 0.9x | 0.77 | x | 2.39 | x | 36.79 | x | 0.63 | x | 0.7 | = | 26.87 | (77) |
| Southeast 0.9x | 0.77 | x | 0.48 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.4 | (77) |

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.4 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 36.79 | x | 0.63 | x | 0.7 | = | 23.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 36.79 | x | 0.63 | x | 0.7 | = | 23.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 62.67 | x | 0.63 | x | 0.7 | = | 45.78 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 62.67 | x | 0.63 | x | 0.7 | = | 40.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.77 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.77 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 62.67 | x | 0.63 | x | 0.7 | = | 40.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 85.75 | x | 0.63 | x | 0.7 | = | 62.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 85.75 | x | 0.63 | x | 0.7 | = | 12.58 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 85.75 | x | 0.63 | x | 0.7 | = | 12.58 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 85.75 | x | 0.63 | x | 0.7 | = | 55.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 85.75 | x | 0.63 | x | 0.7 | = | 13.37 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 85.75 | x | 0.63 | x | 0.7 | = | 13.37 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 85.75 | x | 0.63 | x | 0.7 | = | 55.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 106.25 | x | 0.63 | x | 0.7 | = | 77.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 106.25 | x | 0.63 | x | 0.7 | = | 15.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 106.25 | x | 0.63 | x | 0.7 | = | 15.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 106.25 | x | 0.63 | x | 0.7 | = | 68.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 106.25 | x | 0.63 | x | 0.7 | = | 16.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 106.25 | x | 0.63 | x | 0.7 | = | 16.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 106.25 | x | 0.63 | x | 0.7 | = | 68.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 119.01 | x | 0.63 | x | 0.7 | = | 86.93 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 119.01 | x | 0.63 | x | 0.7 | = | 17.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 119.01 | x | 0.63 | x | 0.7 | = | 17.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 119.01 | x | 0.63 | x | 0.7 | = | 77.11 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 119.01 | x | 0.63 | x | 0.7 | = | 18.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 119.01 | x | 0.63 | x | 0.7 | = | 18.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 119.01 | x | 0.63 | x | 0.7 | = | 77.11 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 118.15 | x | 0.63 | x | 0.7 | = | 86.3 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 118.15 | x | 0.63 | x | 0.7 | = | 17.33 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 118.15 | x | 0.63 | x | 0.7 | = | 17.33 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 118.15 | x | 0.63 | x | 0.7 | = | 76.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 118.15 | x | 0.63 | x | 0.7 | = | 18.42 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 118.15 | x | 0.63 | x | 0.7 | = | 18.42 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 118.15 | x | 0.63 | x | 0.7 | = | 76.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 113.91 | x | 0.63 | x | 0.7 | = | 83.2 | (77) |

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 113.91 | x | 0.63 | x | 0.7 | = | 16.71 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 113.91 | x | 0.63 | x | 0.7 | = | 16.71 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 113.91 | x | 0.63 | x | 0.7 | = | 73.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 113.91 | x | 0.63 | x | 0.7 | = | 17.75 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 113.91 | x | 0.63 | x | 0.7 | = | 17.75 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 113.91 | x | 0.63 | x | 0.7 | = | 73.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 104.39 | x | 0.63 | x | 0.7 | = | 76.25 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 104.39 | x | 0.63 | x | 0.7 | = | 15.31 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 104.39 | x | 0.63 | x | 0.7 | = | 15.31 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 104.39 | x | 0.63 | x | 0.7 | = | 67.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 104.39 | x | 0.63 | x | 0.7 | = | 16.27 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 104.39 | x | 0.63 | x | 0.7 | = | 16.27 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 104.39 | x | 0.63 | x | 0.7 | = | 67.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 92.85 | x | 0.63 | x | 0.7 | = | 67.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 92.85 | x | 0.63 | x | 0.7 | = | 13.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 92.85 | x | 0.63 | x | 0.7 | = | 13.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 92.85 | x | 0.63 | x | 0.7 | = | 60.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 92.85 | x | 0.63 | x | 0.7 | = | 14.47 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 92.85 | x | 0.63 | x | 0.7 | = | 14.47 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 92.85 | x | 0.63 | x | 0.7 | = | 60.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 69.27 | x | 0.63 | x | 0.7 | = | 50.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 69.27 | x | 0.63 | x | 0.7 | = | 44.88 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 69.27 | x | 0.63 | x | 0.7 | = | 44.88 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 44.07 | x | 0.63 | x | 0.7 | = | 32.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 44.07 | x | 0.63 | x | 0.7 | = | 28.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.87 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.87 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 44.07 | x | 0.63 | x | 0.7 | = | 28.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 31.49 | x | 0.63 | x | 0.7 | = | 23 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 31.49 | x | 0.63 | x | 0.7 | = | 20.4 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.91 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.91 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 31.49 | x | 0.63 | x | 0.7 | = | 20.4 | (77) |

# SAP WorkSheet: New dwelling design stage

STUDIO11 architecture

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 119.01 | | 0.63 | x | 0.7 | = | 58.92 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 119.01 | | 0.63 | x | 0.7 | = | 52.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 118.15 | | 0.63 | x | 0.7 | = | 58.5 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 118.15 | | 0.63 | x | 0.7 | = | 52 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 113.91 | | 0.63 | x | 0.7 | = | 56.4 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 113.91 | | 0.63 | x | 0.7 | = | 50.13 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 104.39 | | 0.63 | x | 0.7 | = | 51.68 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 104.39 | | 0.63 | x | 0.7 | = | 45.94 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 92.85 | | 0.63 | x | 0.7 | = | 45.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 92.85 | | 0.63 | x | 0.7 | = | 40.86 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 69.27 | | 0.63 | x | 0.7 | = | 34.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 69.27 | | 0.63 | x | 0.7 | = | 30.48 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 44.07 | | 0.63 | x | 0.7 | = | 21.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 44.07 | | 0.63 | x | 0.7 | = | 19.39 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (79) |
| 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 | 0.51 | x | 11.28 | x | 0.63 | x | 0.7 | = | 1.76 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 11.28 | x | 0.63 | x | 0.7 | = | 17.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 11.28 | x | 0.63 | x | 0.7 | = | 17.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.51 | x | 22.97 | x | 0.63 | x | 0.7 | = | 3.58 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 22.97 | x | 0.63 | x | 0.7 | = | 35.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 22.97 | x | 0.63 | x | 0.7 | = | 35.38 | (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 | 0.51 | x | 41.38 | x | 0.63 | x | 0.7 | = | 6.45 | (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 | 5.04 | x | 41.38 | x | 0.63 | x | 0.7 | = | 63.74 | (81) |

# SAP WorkSheet: New dwelling design stage

STUDIO11 architecture

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 41.38 | x | 0.63 | x | 0.7 | = | 63.74 | (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 | 0.51 | x | 67.96 | x | 0.63 | x | 0.7 | = | 10.59 | (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 | 5.04 | x | 67.96 | x | 0.63 | x | 0.7 | = | 104.67 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 67.96 | x | 0.63 | x | 0.7 | = | 104.67 | (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 | 0.51 | x | 91.35 | x | 0.63 | x | 0.7 | = | 14.24 | (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 | 5.04 | x | 91.35 | x | 0.63 | x | 0.7 | = | 140.7 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 91.35 | x | 0.63 | x | 0.7 | = | 140.7 | (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 | 0.51 | x | 97.38 | x | 0.63 | x | 0.7 | = | 15.18 | (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 | 5.04 | x | 97.38 | x | 0.63 | x | 0.7 | = | 150 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 97.38 | x | 0.63 | x | 0.7 | = | 150 | (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 | 0.51 | x | 91.1 | x | 0.63 | x | 0.7 | = | 14.2 | (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 | 5.04 | x | 91.1 | x | 0.63 | x | 0.7 | = | 140.32 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 91.1 | x | 0.63 | x | 0.7 | = | 140.32 | (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 | 0.51 | x | 72.63 | x | 0.63 | x | 0.7 | = | 11.32 | (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 | 5.04 | x | 72.63 | x | 0.63 | x | 0.7 | = | 111.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 72.63 | x | 0.63 | x | 0.7 | = | 111.87 | (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 | 0.51 | x | 50.42 | x | 0.63 | x | 0.7 | = | 7.86 | (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 | 5.04 | x | 50.42 | x | 0.63 | x | 0.7 | = | 77.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 50.42 | x | 0.63 | x | 0.7 | = | 77.66 | (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 | 0.51 | x | 28.07 | x | 0.63 | x | 0.7 | = | 4.37 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 28.07 | x | 0.63 | x | 0.7 | = | 43.23 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 28.07 | x | 0.63 | x | 0.7 | = | 43.23 | (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 | 0.51 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.21 | (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 | 5.04 | x | 14.2 | x | 0.63 | x | 0.7 | = | 21.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 14.2 | x | 0.63 | x | 0.7 | = | 21.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.51 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.44 | (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 | 5.04 | x | 9.21 | x | 0.63 | x | 0.7 | = | 14.19 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 9.21 | x | 0.63 | x | 0.7 | = | 14.19 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 185.19 | 333.37 | 503.75 | 703.97 | 861.35 | 887.16 | 841.98 | 719.67 | 572.31 | 381.28 | 225.08 | 156.37 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 982 | 1124.79 | 1266.19 | 1421.06 | 1531.21 | 1515.23 | 1445.96 | 1333.38 | 1212.41 | 1066.98 | 961.51 | 931.96 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.98 | 0.95 | 0.87 | 0.71 | 0.54 | 0.6 | 0.84 | 0.97 | 0.99 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.61 | 19.77 | 20.05 | 20.43 | 20.74 | 20.93 | 20.98 | 20.97 | 20.84 | 20.43 | 19.96 | 19.59 | (87) |

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.93 | 0.82 | 0.61 | 0.41 | 0.47 | 0.77 | 0.96 | 0.99 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18 | 18.24 | 18.64 | 19.19 | 19.61 | 19.82 | 19.86 | 19.86 | 19.74 | 19.2 | 18.52 | 17.98 | (90) |

fLA = Living area ÷ (4) = 0.18 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.29 | 18.52 | 18.9 | 19.41 | 19.82 | 20.03 | 20.07 | 20.07 | 19.94 | 19.43 | 18.78 | 18.27 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.14 | 18.37 | 18.75 | 19.26 | 19.67 | 19.88 | 19.92 | 19.92 | 19.79 | 19.28 | 18.63 | 18.12 | (93) |

## 8. Space heating requirement

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

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

Utilisation factor for gains, hm:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (94)m= | 0.99 | 0.99 | 0.97 | 0.92 | 0.81 | 0.61 | 0.42 | 0.48 | 0.76 | 0.94 | 0.99 | 0.99 | (94) |

# SAP WorkSheet: New dwelling design stage

STUDIO11 architecture

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 975.02 | 1109.71 | 1228.77 | 1311.15 | 1239.77 | 924.02 | 604.76 | 634.26 | 921.88 | 1008.23 | 948.52 | 926.68 | (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= | 2652.2 | 2572.03 | 2331.37 | 1941 | 1487.59 | 971.86 | 611.18 | 645.7 | 1053.16 | 1620.23 | 2166.92 | 2632.15 | (97) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 1247.82 | 982.68 | 820.33 | 453.49 | 184.38 | 0 | 0 | 0 | 0 | 455.33 | 877.25 | 1268.87 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 6290.13 (98)

Space heating requirement in kWh/m²/year 43.2 (99)

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

**Space heating:**

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

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

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

Efficiency of main space heating system 1 90 (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) | 1247.82 | 982.68 | 820.33 | 453.49 | 184.38 | 0 | 0 | 0 | 0 | 455.33 | 877.25 | 1268.87 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 1386.46 | 1091.86 | 911.48 | 503.88 | 204.86 | 0 | 0 | 0 | 0 | 505.92 | 974.72 | 1409.85 | (211) |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 6989.04 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

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

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

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 227.35 | 200.51 | 210.86 | 189.41 | 185.9 | 166.51 | 160.3 | 175.37 | 174.89 | 196.39 | 207.17 | 222.01 | |

Efficiency of water heater 79.3 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 88.17 | 87.99 | 87.58 | 86.56 | 84.29 | 79.3 | 79.3 | 79.3 | 79.3 | 86.48 | 87.74 | 88.23 | (217) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 257.86 | 227.88 | 240.75 | 218.82 | 220.54 | 209.97 | 202.14 | 221.14 | 220.54 | 227.08 | 236.12 | 251.64 | |

Total = Sum(219a)$_{1...12}$ = 2734.49 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 6989.04 |
| Water heating fuel used | | 2734.49 |
| Electricity for pumps, fans and electric keep-hot | | |
| central heating pump: | 30 | (230c) |

# SAP WorkSheet: New dwelling design stage

STUDIO11 architecture

| | | | | |
|---|---|---|---|---|
| boiler with a fan-assisted flue | | | 45 | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 497.6 | (232) |
| Electricity generated by PVs | | | -1204.8 | (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 = | 243.22 | (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 = | 95.16 | (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 = | 65.63 | (250) |
| Additional standing charges (Table 12) | | | | | | 120 | (251) |
| | one of (233) to (235) x) | | | 13.19 | x 0.01 = | -158.91 | (252) |
| Appendix Q items: repeat lines (253) and (254) as needed | | | | | | | |
| **Total energy cost** | (245)...(247) + (250)…(254) = | | | | | 374.99 | (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 rating (Section 12)** | | 88.47 (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 | = | 1509.63 | (261) |
| Space heating (secondary) | (215) | x | | 0.519 | = | 0 | (263) |
| Water heating | (219) | x | | 0.216 | = | 590.65 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | | 2100.28 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) | x | | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) | x | | 0.519 | = | 258.26 | (268) |
| Energy saving/generation technologies | | | | | | | |
| Item 1 | | | | 0.519 | = | -625.29 | (269) |
| Total CO2, kg/year | sum of (265)…(271) = | | | | | 1772.18 | (272) |
| **CO2 emissions per m²** | (272) ÷ (4) = | | | | | 12.17 | (273) |
| EI rating (section 14) | | | | | | 88 | (274) |

# SAP WorkSheet: New dwelling design stage

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## 13a. Primary Energy

| | Energy kWh/year | | Primary factor | | P. Energy kWh/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) | x | 1.22 | = | 8526.63 | (261) |
| Space heating (secondary) | (215) | x | 3.07 | = | 0 | (263) |
| Energy for water heating | (219) | x | 1.22 | = | 3336.08 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 11862.71 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) | x | 3.07 | = | 230.25 | (267) |
| Electricity for lighting | (232) | x | 0 | = | 1527.64 | (268) |
| Energy saving/generation technologies Item 1 | | | 3.07 | = | -3698.72 | (269) |
| 'Total Primary Energy | | sum of (265)…(271) = | | | 9921.88 | (272) |
| **Primary energy kWh/m²/year** | | (272) ÷ (4) = | | | 68.14 | (273) |

# Target Fabric Energy Efficiency 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 8

**Address :** Plot 8 , Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 72.8 (1a) | x | 2.4 (2a) | = | 174.72 | (3a) |
| Ground floor | 72.8 (1b) | x | 2.6 (2b) | = | 189.28 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 145.6 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 364 | (5) |

## 2. Ventilation rate:

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

| | | | Air changes per hour | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.11 | (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) | | | 0.36 (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) = | | 0.36 (21) |

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.46 | 0.45 | 0.44 | 0.4 | 0.39 | 0.34 | 0.34 | 0.33 | 0.36 | 0.39 | 0.4 | 0.42 |

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

(24d)

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

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

(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 Type 1 | | | 2.12 | x | 1.2 | = | 2.544 | | | (26) |
| Doors Type 2 | | | 1.97 | x | 1.2 | = | 2.364 | | | (26) |
| Windows Type 1 | | | 2.39 | x1/[1/( 1.4 )+ 0.04] | | = | 3.17 | | | (27) |
| Windows Type 2 | | | 0.48 | x1/[1/( 1.4 )+ 0.04] | | = | 0.64 | | | (27) |
| Windows Type 3 | | | 0.48 | x1/[1/( 1.4 )+ 0.04] | | = | 0.64 | | | (27) |
| Windows Type 4 | | | 1.62 | x1/[1/( 1.4 )+ 0.04] | | = | 2.15 | | | (27) |
| Windows Type 5 | | | 0.76 | x1/[1/( 1.4 )+ 0.04] | | = | 1.01 | | | (27) |
| Windows Type 6 | | | 0.76 | x1/[1/( 1.4 )+ 0.04] | | = | 1.01 | | | (27) |
| Windows Type 7 | | | 2.12 | x1/[1/( 1.4 )+ 0.04] | | = | 2.81 | | | (27) |
| Windows Type 8 | | | 0.51 | x1/[1/( 1.4 )+ 0.04] | | = | 0.68 | | | (27) |
| Windows Type 9 | | | 0.51 | x1/[1/( 1.4 )+ 0.04] | | = | 0.68 | | | (27) |
| Windows Type 10 | | | 2.12 | x1/[1/( 1.4 )+ 0.04] | | = | 2.81 | | | (27) |
| Windows Type 11 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 12 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 13 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 14 | | | 0.51 | x1/[1/( 1.4 )+ 0.04] | | = | 0.68 | | | (27) |
| Windows Type 15 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 16 | | | 5.04 | x1/[1/( 1.4 )+ 0.04] = | 6.68 | | | | (27) |
| Windows Type 17 | | | 5.04 | x1/[1/( 1.4 )+ 0.04] = | 6.68 | | | | (27) |
| Floor | | | 72.8 | x 0.13 = | 9.464 | | | | (28) |
| Walls | 173.35 | 31.41 | 141.94 | x 0.18 = | 25.55 | | | | (29) |
| Roof | 72.8 | 0 | 72.8 | x 0.13 = | 9.46 | | | | (30) |
| Total area of elements, m² | | | 318.95 | | | | | | (31) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 85.6 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 14631.6 (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 14.08 (36)

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

Total fabric heat loss (33) + (36) = 99.69 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 72.71 | 72.21 | 71.73 | 69.47 | 69.05 | 67.08 | 67.08 | 66.72 | 67.84 | 69.05 | 69.91 | 70.8 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 172.39 | 171.9 | 171.42 | 169.16 | 168.74 | 166.77 | 166.77 | 166.4 | 167.53 | 168.74 | 169.59 | 170.49 | |

Average = Sum(39)$_{1...12}$ /12= 169.16 (39)

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

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

Average = Sum(40)$_{1...12}$ /12= 1.16 (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 2.93 (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) + 36 103.72 (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= | 114.09 | 109.94 | 105.79 | 101.64 | 97.49 | 93.35 | 93.35 | 97.49 | 101.64 | 105.79 | 109.94 | 114.09 | |

Total = Sum(44)$_{1...12}$ = 1244.62 (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= | 169.19 | 147.98 | 152.7 | 133.13 | 127.74 | 110.23 | 102.14 | 117.21 | 118.61 | 138.23 | 150.89 | 163.85 | |

Total = Sum(45)$_{1...12}$ = 1631.89 (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) |

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Water storage loss:

| | | | |
|---|---|---|---|
| Storage volume (litres) including any solar or WWHRS storage within same vessel | | 150 | (47) |

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

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

Water storage loss:

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

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= | 143.81 | 125.78 | 129.79 | 113.16 | 108.58 | 93.69 | 86.82 | 99.63 | 100.82 | 117.49 | 128.25 | 139.28 | (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= | 143.81 | 125.78 | 129.79 | 113.16 | 108.58 | 93.69 | 86.82 | 99.63 | 100.82 | 117.49 | 128.25 | 139.28 | |

Output from water heater (annual)$_{1...12}$ 1387.1 (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= | 35.95 | 31.44 | 32.45 | 28.29 | 27.14 | 23.42 | 21.71 | 24.91 | 25.2 | 29.37 | 32.06 | 34.82 | (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= | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 28.18 | 25.03 | 20.35 | 15.41 | 11.52 | 9.72 | 10.51 | 13.66 | 18.33 | 23.28 | 27.17 | 28.96 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 315.69 | 318.97 | 310.71 | 293.14 | 270.96 | 250.11 | 236.18 | 232.9 | 241.16 | 258.73 | 280.91 | 301.76 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | (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= | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 48.32 | 46.79 | 43.61 | 39.29 | 36.48 | 32.53 | 29.17 | 33.48 | 35.01 | 39.48 | 44.53 | 46.8 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 459.1 | 457.7 | 441.59 | 414.75 | 385.86 | 359.27 | 342.76 | 346.94 | 361.4 | 388.39 | 419.52 | 444.43 | (73) |

## 6. Solar gains:

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

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast 0.9x | 0.77 | x | 0.76 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 22.97 | x | 0.63 | x | 0.7 | = | 5.33 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 22.97 | x | 0.63 | x | 0.7 | = | 5.33 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 41.38 | x | 0.63 | x | 0.7 | = | 9.61 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 41.38 | x | 0.63 | x | 0.7 | = | 9.61 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 67.96 | x | 0.63 | x | 0.7 | = | 15.78 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 67.96 | x | 0.63 | x | 0.7 | = | 15.78 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.35 | x | 0.63 | x | 0.7 | = | 21.22 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.35 | x | 0.63 | x | 0.7 | = | 21.22 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 97.38 | x | 0.63 | x | 0.7 | = | 22.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 97.38 | x | 0.63 | x | 0.7 | = | 22.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.1 | x | 0.63 | x | 0.7 | = | 21.16 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.1 | x | 0.63 | x | 0.7 | = | 21.16 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 72.63 | x | 0.63 | x | 0.7 | = | 16.87 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 72.63 | x | 0.63 | x | 0.7 | = | 16.87 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 50.42 | x | 0.63 | x | 0.7 | = | 11.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 50.42 | x | 0.63 | x | 0.7 | = | 11.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 28.07 | x | 0.63 | x | 0.7 | = | 6.52 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 28.07 | x | 0.63 | x | 0.7 | = | 6.52 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 14.2 | x | 0.63 | x | 0.7 | = | 3.3 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 14.2 | x | 0.63 | x | 0.7 | = | 3.3 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 9.21 | x | 0.63 | x | 0.7 | = | 2.14 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 9.21 | x | 0.63 | x | 0.7 | = | 2.14 | (75) |
| Southeast 0.9x | 0.77 | x | 2.39 | x | 36.79 | x | 0.63 | x | 0.7 | = | 26.87 | (77) |
| Southeast 0.9x | 0.77 | x | 0.48 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.4 | (77) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stag




| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.4 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 36.79 | x | 0.63 | x | 0.7 | = | 23.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 36.79 | x | 0.63 | x | 0.7 | = | 23.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 62.67 | x | 0.63 | x | 0.7 | = | 45.78 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 62.67 | x | 0.63 | x | 0.7 | = | 40.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.77 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.77 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 62.67 | x | 0.63 | x | 0.7 | = | 40.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 85.75 | x | 0.63 | x | 0.7 | = | 62.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 85.75 | x | 0.63 | x | 0.7 | = | 12.58 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 85.75 | x | 0.63 | x | 0.7 | = | 12.58 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 85.75 | x | 0.63 | x | 0.7 | = | 55.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 85.75 | x | 0.63 | x | 0.7 | = | 13.37 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 85.75 | x | 0.63 | x | 0.7 | = | 13.37 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 85.75 | x | 0.63 | x | 0.7 | = | 55.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 106.25 | x | 0.63 | x | 0.7 | = | 77.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 106.25 | x | 0.63 | x | 0.7 | = | 15.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 106.25 | x | 0.63 | x | 0.7 | = | 15.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 106.25 | x | 0.63 | x | 0.7 | = | 68.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 106.25 | x | 0.63 | x | 0.7 | = | 16.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 106.25 | x | 0.63 | x | 0.7 | = | 16.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 106.25 | x | 0.63 | x | 0.7 | = | 68.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 119.01 | x | 0.63 | x | 0.7 | = | 86.93 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 119.01 | x | 0.63 | x | 0.7 | = | 17.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 119.01 | x | 0.63 | x | 0.7 | = | 17.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 119.01 | x | 0.63 | x | 0.7 | = | 77.11 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 119.01 | x | 0.63 | x | 0.7 | = | 18.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 119.01 | x | 0.63 | x | 0.7 | = | 18.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 119.01 | x | 0.63 | x | 0.7 | = | 77.11 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 118.15 | x | 0.63 | x | 0.7 | = | 86.3 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 118.15 | x | 0.63 | x | 0.7 | = | 17.33 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 118.15 | x | 0.63 | x | 0.7 | = | 17.33 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 118.15 | x | 0.63 | x | 0.7 | = | 76.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 118.15 | x | 0.63 | x | 0.7 | = | 18.42 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 118.15 | x | 0.63 | x | 0.7 | = | 18.42 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 118.15 | x | 0.63 | x | 0.7 | = | 76.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 113.91 | x | 0.63 | x | 0.7 | = | 83.2 | (77) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stag

STUDIO11 architecture

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 113.91 | x | 0.63 | x | 0.7 | = | 16.71 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 113.91 | x | 0.63 | x | 0.7 | = | 16.71 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 113.91 | x | 0.63 | x | 0.7 | = | 73.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 113.91 | x | 0.63 | x | 0.7 | = | 17.75 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 113.91 | x | 0.63 | x | 0.7 | = | 17.75 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 113.91 | x | 0.63 | x | 0.7 | = | 73.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 104.39 | x | 0.63 | x | 0.7 | = | 76.25 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 104.39 | x | 0.63 | x | 0.7 | = | 15.31 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 104.39 | x | 0.63 | x | 0.7 | = | 15.31 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 104.39 | x | 0.63 | x | 0.7 | = | 67.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 104.39 | x | 0.63 | x | 0.7 | = | 16.27 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 104.39 | x | 0.63 | x | 0.7 | = | 16.27 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 104.39 | x | 0.63 | x | 0.7 | = | 67.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 92.85 | x | 0.63 | x | 0.7 | = | 67.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 92.85 | x | 0.63 | x | 0.7 | = | 13.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 92.85 | x | 0.63 | x | 0.7 | = | 13.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 92.85 | x | 0.63 | x | 0.7 | = | 60.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 92.85 | x | 0.63 | x | 0.7 | = | 14.47 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 92.85 | x | 0.63 | x | 0.7 | = | 14.47 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 92.85 | x | 0.63 | x | 0.7 | = | 60.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 69.27 | x | 0.63 | x | 0.7 | = | 50.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 69.27 | x | 0.63 | x | 0.7 | = | 44.88 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 69.27 | x | 0.63 | x | 0.7 | = | 44.88 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 44.07 | x | 0.63 | x | 0.7 | = | 32.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 44.07 | x | 0.63 | x | 0.7 | = | 28.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.87 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.87 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 44.07 | x | 0.63 | x | 0.7 | = | 28.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 31.49 | x | 0.63 | x | 0.7 | = | 23 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 31.49 | x | 0.63 | x | 0.7 | = | 20.4 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.91 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.91 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 31.49 | x | 0.63 | x | 0.7 | = | 20.4 | (77) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stag

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 119.01 | | 0.63 | x | 0.7 | = | 58.92 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 119.01 | | 0.63 | x | 0.7 | = | 52.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 118.15 | | 0.63 | x | 0.7 | = | 58.5 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 118.15 | | 0.63 | x | 0.7 | = | 52 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 113.91 | | 0.63 | x | 0.7 | = | 56.4 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 113.91 | | 0.63 | x | 0.7 | = | 50.13 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 104.39 | | 0.63 | x | 0.7 | = | 51.68 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 104.39 | | 0.63 | x | 0.7 | = | 45.94 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 92.85 | | 0.63 | x | 0.7 | = | 45.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 92.85 | | 0.63 | x | 0.7 | = | 40.86 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 69.27 | | 0.63 | x | 0.7 | = | 34.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 69.27 | | 0.63 | x | 0.7 | = | 30.48 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 44.07 | | 0.63 | x | 0.7 | = | 21.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 44.07 | | 0.63 | x | 0.7 | = | 19.39 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (79) |
| 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 | 0.51 | x | 11.28 | x | 0.63 | x | 0.7 | = | 1.76 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 11.28 | x | 0.63 | x | 0.7 | = | 17.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 11.28 | x | 0.63 | x | 0.7 | = | 17.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.51 | x | 22.97 | x | 0.63 | x | 0.7 | = | 3.58 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 22.97 | x | 0.63 | x | 0.7 | = | 35.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 22.97 | x | 0.63 | x | 0.7 | = | 35.38 | (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 | 0.51 | x | 41.38 | x | 0.63 | x | 0.7 | = | 6.45 | (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 | 5.04 | x | 41.38 | x | 0.63 | x | 0.7 | = | 63.74 | (81) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stag

STUDIO11 architecture

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 41.38 | x | 0.63 | x | 0.7 | = | 63.74 | (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 | 0.51 | x | 67.96 | x | 0.63 | x | 0.7 | = | 10.59 | (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 | 5.04 | x | 67.96 | x | 0.63 | x | 0.7 | = | 104.67 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 67.96 | x | 0.63 | x | 0.7 | = | 104.67 | (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 | 0.51 | x | 91.35 | x | 0.63 | x | 0.7 | = | 14.24 | (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 | 5.04 | x | 91.35 | x | 0.63 | x | 0.7 | = | 140.7 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 91.35 | x | 0.63 | x | 0.7 | = | 140.7 | (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 | 0.51 | x | 97.38 | x | 0.63 | x | 0.7 | = | 15.18 | (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 | 5.04 | x | 97.38 | x | 0.63 | x | 0.7 | = | 150 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 97.38 | x | 0.63 | x | 0.7 | = | 150 | (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 | 0.51 | x | 91.1 | x | 0.63 | x | 0.7 | = | 14.2 | (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 | 5.04 | x | 91.1 | x | 0.63 | x | 0.7 | = | 140.32 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 91.1 | x | 0.63 | x | 0.7 | = | 140.32 | (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 | 0.51 | x | 72.63 | x | 0.63 | x | 0.7 | = | 11.32 | (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 | 5.04 | x | 72.63 | x | 0.63 | x | 0.7 | = | 111.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 72.63 | x | 0.63 | x | 0.7 | = | 111.87 | (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 | 0.51 | x | 50.42 | x | 0.63 | x | 0.7 | = | 7.86 | (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 | 5.04 | x | 50.42 | x | 0.63 | x | 0.7 | = | 77.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 50.42 | x | 0.63 | x | 0.7 | = | 77.66 | (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 | 0.51 | x | 28.07 | x | 0.63 | x | 0.7 | = | 4.37 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stag

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 28.07 | x | 0.63 | x | 0.7 | = | 43.23 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 28.07 | x | 0.63 | x | 0.7 | = | 43.23 | (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 | 0.51 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.21 | (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 | 5.04 | x | 14.2 | x | 0.63 | x | 0.7 | = | 21.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 14.2 | x | 0.63 | x | 0.7 | = | 21.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.51 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.44 | (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 | 5.04 | x | 9.21 | x | 0.63 | x | 0.7 | = | 14.19 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 9.21 | x | 0.63 | x | 0.7 | = | 14.19 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 185.19 | 333.37 | 503.75 | 703.97 | 861.35 | 887.16 | 841.98 | 719.67 | 572.31 | 381.28 | 225.08 | 156.37 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 644.29 | 791.07 | 945.33 | 1118.71 | 1247.21 | 1246.43 | 1184.74 | 1066.61 | 933.71 | 769.68 | 644.6 | 600.8 | (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 | 0.91 | 0.76 | 0.6 | 0.67 | 0.91 | 0.99 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.57 | 19.73 | 20.01 | 20.39 | 20.72 | 20.93 | 20.98 | 20.97 | 20.8 | 20.36 | 19.9 | 19.55 | (87) |

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.97 | 0.88 | 0.67 | 0.47 | 0.54 | 0.85 | 0.99 | 1 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.62 | 18.78 | 19.06 | 19.44 | 19.76 | 19.93 | 19.96 | 19.96 | 19.84 | 19.43 | 18.96 | 18.6 | (90) |

fLA = Living area ÷ (4) = 0.18 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.79 | 18.96 | 19.24 | 19.62 | 19.94 | 20.11 | 20.15 | 20.14 | 20.02 | 19.6 | 19.13 | 18.78 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.79 | 18.96 | 19.24 | 19.62 | 19.94 | 20.11 | 20.15 | 20.14 | 20.02 | 19.6 | 19.13 | 18.78 | (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 | 0.96 | 0.87 | 0.69 | 0.49 | 0.57 | 0.86 | 0.98 | 1 | 1 | (94) |

# Target Fabric Energy Efficiency WorkSheet: New dwelling design stag

STUDIO11 architecture

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 643.67 | 788.88 | 936.64 | 1077.83 | 1091.14 | 857.45 | 582.61 | 605.1 | 801.08 | 756.7 | 643.17 | 600.4 | (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= | 2498.45 | 2416.68 | 2183.25 | 1812.98 | 1389.85 | 919.25 | 591.69 | 622.92 | 991.41 | 1518.22 | 2040.73 | 2485.33 | (97) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 1379.95 | 1093.88 | 927.48 | 529.31 | 222.25 | 0 | 0 | 0 | 0 | 566.57 | 1006.24 | 1402.39 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 7128.07 (98)

Space heating requirement in kWh/m²/year 48.96 (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 | 1567.62 | 1234.09 | 1264.67 | 0 | 0 | 0 | 0 | (100) |
| Utilisation factor for loss hm | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.84 | 0.91 | 0.87 | 0 | 0 | 0 | 0 | (101) |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 1313.74 | 1117.43 | 1095.66 | 0 | 0 | 0 | 0 | (102) |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 1581.1 | 1506.11 | 1370.44 | 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 | 192.5 | 289.17 | 204.44 | 0 | 0 | 0 | 0 | |

Total = Sum(104)$_{5...9}$ = 686.12 (104)

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

Intermittency factor (Table 10b)

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

*Total = Sum(104)*$_{5...9}$ = 0 (106)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (107)m= | 0 | 0 | 0 | 0 | 0 | 48.13 | 72.29 | 51.11 | 0 | 0 | 0 | 0 | |

Total = Sum(107)$_{5...9}$ = 171.53 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.18 (108)

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

Fabric Energy Efficiency (99) + (108) = 50.13 (109)

**Target Fabric Energy Efficiency (TFEE)** 57.65 (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 8

**Address :** Plot 8 , Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 72.8 | (1a) x | 2.4 | (2a) = | 174.72 | (3a) |
| Ground floor | 72.8 | (1b) x | 2.6 | (2b) = | 189.28 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 145.6 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 364 | (5) |

## 2. Ventilation rate:

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

| | | | Air changes per hour | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.11 (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) | 0.36 (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) = | 0.36 (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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.46 | 0.45 | 0.44 | 0.4 | 0.39 | 0.34 | 0.34 | 0.33 | 0.36 | 0.39 | 0.4 | 0.42 |

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

(24d)

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

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

(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 Type 1 | | | 2.12 | x | 1.2 | = | 2.544 | | | (26) |
| Doors Type 2 | | | 1.97 | x | 1.2 | = | 2.364 | | | (26) |
| Windows Type 1 | | | 2.39 | x1/[1/( 1.2 )+ 0.04] | | = | 2.74 | | | (27) |
| Windows Type 2 | | | 0.48 | x1/[1/( 1.2 )+ 0.04] | | = | 0.55 | | | (27) |
| Windows Type 3 | | | 0.48 | x1/[1/( 1.2 )+ 0.04] | | = | 0.55 | | | (27) |
| Windows Type 4 | | | 1.62 | x1/[1/( 1.2 )+ 0.04] | | = | 1.85 | | | (27) |
| Windows Type 5 | | | 0.76 | x1/[1/( 1.2 )+ 0.04] | | = | 0.87 | | | (27) |
| Windows Type 6 | | | 0.76 | x1/[1/( 1.2 )+ 0.04] | | = | 0.87 | | | (27) |
| Windows Type 7 | | | 2.12 | x1/[1/( 1.2 )+ 0.04] | | = | 2.43 | | | (27) |
| Windows Type 8 | | | 0.51 | x1/[1/( 1.2 )+ 0.04] | | = | 0.58 | | | (27) |
| Windows Type 9 | | | 0.51 | x1/[1/( 1.2 )+ 0.04] | | = | 0.58 | | | (27) |
| Windows Type 10 | | | 2.12 | x1/[1/( 1.2 )+ 0.04] | | = | 2.43 | | | (27) |
| Windows Type 11 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 12 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 13 | | | 0.66 | x1/[1/( 1.2 )+ 0.04] | | = | 0.76 | | | (27) |
| Windows Type 14 | | | 0.51 | x1/[1/( 1.2 )+ 0.04] | | = | 0.58 | | | (27) |
| Windows Type 15 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design sta

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 16 | | | 5.04 | x1/[1/( 1.2 )+ 0.04] = | 5.77 | | | | (27) |
| Windows Type 17 | | | 5.04 | x1/[1/( 1.2 )+ 0.04] = | 5.77 | | | | (27) |
| Floor | | | 72.8 | x 0.12 = | 8.736 | | | | (28) |
| Walls | 173.35 | 31.41 | 141.94 | x 0.24 = | 34.07 | | | | (29) |
| Roof | 72.8 | 0 | 72.8 | x 0.09 = | 6.55 | | | | (30) |
| Total area of elements, m² | | | 318.95 | | | | | | (31) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 85.54 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 14631.6 (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 29.17 (36)

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

Total fabric heat loss (33) + (36) = 114.72 (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= | 72.71 | 72.21 | 71.73 | 69.47 | 69.05 | 67.08 | 67.08 | 66.72 | 67.84 | 69.05 | 69.91 | 70.8 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 187.42 | 186.93 | 186.45 | 184.19 | 183.77 | 181.8 | 181.8 | 181.43 | 182.56 | 183.77 | 184.62 | 185.52 | |

Average = Sum(39)$_{1...12}$ /12= 184.19 (39)

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

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

Average = Sum(40)$_{1...12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

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

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

Assumed occupancy, N 2.93 (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) + 36 103.72 (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= | 114.09 | 109.94 | 105.79 | 101.64 | 97.49 | 93.35 | 93.35 | 97.49 | 101.64 | 105.79 | 109.94 | 114.09 | |

Total = Sum(44)$_{1...12}$ = 1244.62 (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= | 169.19 | 147.98 | 152.7 | 133.13 | 127.74 | 110.23 | 102.14 | 117.21 | 118.61 | 138.23 | 150.89 | 163.85 | |

Total = Sum(45)$_{1...12}$ = 1631.89 (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 | | 210 | (47) |

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

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

Water storage loss:

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

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= | 143.81 | 125.78 | 129.79 | 113.16 | 108.58 | 93.69 | 86.82 | 99.63 | 100.82 | 117.49 | 128.25 | 139.28 | (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= | 143.81 | 125.78 | 129.79 | 113.16 | 108.58 | 93.69 | 86.82 | 99.63 | 100.82 | 117.49 | 128.25 | 139.28 | |

Output from water heater (annual)$_{1...12}$ 1387.1 (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= | 35.95 | 31.44 | 32.45 | 28.29 | 27.14 | 23.42 | 21.71 | 24.91 | 25.2 | 29.37 | 32.06 | 34.82 | (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= | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 28.18 | 25.03 | 20.35 | 15.41 | 11.52 | 9.72 | 10.51 | 13.66 | 18.33 | 23.28 | 27.17 | 28.96 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 315.69 | 318.97 | 310.71 | 293.14 | 270.96 | 250.11 | 236.18 | 232.9 | 241.16 | 258.73 | 280.91 | 301.76 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | (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= | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 48.32 | 46.79 | 43.61 | 39.29 | 36.48 | 32.53 | 29.17 | 33.48 | 35.01 | 39.48 | 44.53 | 46.8 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 459.1 | 457.7 | 441.59 | 414.75 | 385.86 | 359.27 | 342.76 | 346.94 | 361.4 | 388.39 | 419.52 | 444.43 | (73) |

## 6. Solar gains:

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

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast 0.9x | 0.77 | x | 0.76 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 22.97 | x | 0.63 | x | 0.7 | = | 5.33 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 22.97 | x | 0.63 | x | 0.7 | = | 5.33 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 41.38 | x | 0.63 | x | 0.7 | = | 9.61 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 41.38 | x | 0.63 | x | 0.7 | = | 9.61 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 67.96 | x | 0.63 | x | 0.7 | = | 15.78 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 67.96 | x | 0.63 | x | 0.7 | = | 15.78 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.35 | x | 0.63 | x | 0.7 | = | 21.22 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.35 | x | 0.63 | x | 0.7 | = | 21.22 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 97.38 | x | 0.63 | x | 0.7 | = | 22.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 97.38 | x | 0.63 | x | 0.7 | = | 22.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.1 | x | 0.63 | x | 0.7 | = | 21.16 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.1 | x | 0.63 | x | 0.7 | = | 21.16 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 72.63 | x | 0.63 | x | 0.7 | = | 16.87 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 72.63 | x | 0.63 | x | 0.7 | = | 16.87 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 50.42 | x | 0.63 | x | 0.7 | = | 11.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 50.42 | x | 0.63 | x | 0.7 | = | 11.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 28.07 | x | 0.63 | x | 0.7 | = | 6.52 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 28.07 | x | 0.63 | x | 0.7 | = | 6.52 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 14.2 | x | 0.63 | x | 0.7 | = | 3.3 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 14.2 | x | 0.63 | x | 0.7 | = | 3.3 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 9.21 | x | 0.63 | x | 0.7 | = | 2.14 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 9.21 | x | 0.63 | x | 0.7 | = | 2.14 | (75) |
| Southeast 0.9x | 0.77 | x | 2.39 | x | 36.79 | x | 0.63 | x | 0.7 | = | 26.87 | (77) |
| Southeast 0.9x | 0.77 | x | 0.48 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.4 | (77) |

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.4 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 36.79 | x | 0.63 | x | 0.7 | = | 23.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 36.79 | x | 0.63 | x | 0.7 | = | 23.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 62.67 | x | 0.63 | x | 0.7 | = | 45.78 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 62.67 | x | 0.63 | x | 0.7 | = | 40.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.77 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.77 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 62.67 | x | 0.63 | x | 0.7 | = | 40.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 85.75 | x | 0.63 | x | 0.7 | = | 62.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 85.75 | x | 0.63 | x | 0.7 | = | 12.58 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 85.75 | x | 0.63 | x | 0.7 | = | 12.58 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 85.75 | x | 0.63 | x | 0.7 | = | 55.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 85.75 | x | 0.63 | x | 0.7 | = | 13.37 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 85.75 | x | 0.63 | x | 0.7 | = | 13.37 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 85.75 | x | 0.63 | x | 0.7 | = | 55.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 106.25 | x | 0.63 | x | 0.7 | = | 77.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 106.25 | x | 0.63 | x | 0.7 | = | 15.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 106.25 | x | 0.63 | x | 0.7 | = | 15.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 106.25 | x | 0.63 | x | 0.7 | = | 68.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 106.25 | x | 0.63 | x | 0.7 | = | 16.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 106.25 | x | 0.63 | x | 0.7 | = | 16.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 106.25 | x | 0.63 | x | 0.7 | = | 68.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 119.01 | x | 0.63 | x | 0.7 | = | 86.93 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 119.01 | x | 0.63 | x | 0.7 | = | 17.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 119.01 | x | 0.63 | x | 0.7 | = | 17.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 119.01 | x | 0.63 | x | 0.7 | = | 77.11 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 119.01 | x | 0.63 | x | 0.7 | = | 18.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 119.01 | x | 0.63 | x | 0.7 | = | 18.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 119.01 | x | 0.63 | x | 0.7 | = | 77.11 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 118.15 | x | 0.63 | x | 0.7 | = | 86.3 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 118.15 | x | 0.63 | x | 0.7 | = | 17.33 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 118.15 | x | 0.63 | x | 0.7 | = | 17.33 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 118.15 | x | 0.63 | x | 0.7 | = | 76.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 118.15 | x | 0.63 | x | 0.7 | = | 18.42 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 118.15 | x | 0.63 | x | 0.7 | = | 18.42 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 118.15 | x | 0.63 | x | 0.7 | = | 76.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 113.91 | x | 0.63 | x | 0.7 | = | 83.2 | (77) |

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 113.91 | x | 0.63 | x | 0.7 | = | 16.71 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 113.91 | x | 0.63 | x | 0.7 | = | 16.71 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 113.91 | x | 0.63 | x | 0.7 | = | 73.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 113.91 | x | 0.63 | x | 0.7 | = | 17.75 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 113.91 | x | 0.63 | x | 0.7 | = | 17.75 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 113.91 | x | 0.63 | x | 0.7 | = | 73.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 104.39 | x | 0.63 | x | 0.7 | = | 76.25 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 104.39 | x | 0.63 | x | 0.7 | = | 15.31 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 104.39 | x | 0.63 | x | 0.7 | = | 15.31 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 104.39 | x | 0.63 | x | 0.7 | = | 67.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 104.39 | x | 0.63 | x | 0.7 | = | 16.27 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 104.39 | x | 0.63 | x | 0.7 | = | 16.27 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 104.39 | x | 0.63 | x | 0.7 | = | 67.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 92.85 | x | 0.63 | x | 0.7 | = | 67.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 92.85 | x | 0.63 | x | 0.7 | = | 13.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 92.85 | x | 0.63 | x | 0.7 | = | 13.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 92.85 | x | 0.63 | x | 0.7 | = | 60.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 92.85 | x | 0.63 | x | 0.7 | = | 14.47 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 92.85 | x | 0.63 | x | 0.7 | = | 14.47 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 92.85 | x | 0.63 | x | 0.7 | = | 60.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 69.27 | x | 0.63 | x | 0.7 | = | 50.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 69.27 | x | 0.63 | x | 0.7 | = | 44.88 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 69.27 | x | 0.63 | x | 0.7 | = | 44.88 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 44.07 | x | 0.63 | x | 0.7 | = | 32.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 44.07 | x | 0.63 | x | 0.7 | = | 28.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.87 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.87 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 44.07 | x | 0.63 | x | 0.7 | = | 28.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 31.49 | x | 0.63 | x | 0.7 | = | 23 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 31.49 | x | 0.63 | x | 0.7 | = | 20.4 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.91 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.91 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 31.49 | x | 0.63 | x | 0.7 | = | 20.4 | (77) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design sta

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 119.01 | | 0.63 | x | 0.7 | = | 58.92 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 119.01 | | 0.63 | x | 0.7 | = | 52.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 118.15 | | 0.63 | x | 0.7 | = | 58.5 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 118.15 | | 0.63 | x | 0.7 | = | 52 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 113.91 | | 0.63 | x | 0.7 | = | 56.4 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 113.91 | | 0.63 | x | 0.7 | = | 50.13 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 104.39 | | 0.63 | x | 0.7 | = | 51.68 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 104.39 | | 0.63 | x | 0.7 | = | 45.94 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 92.85 | | 0.63 | x | 0.7 | = | 45.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 92.85 | | 0.63 | x | 0.7 | = | 40.86 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 69.27 | | 0.63 | x | 0.7 | = | 34.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 69.27 | | 0.63 | x | 0.7 | = | 30.48 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 44.07 | | 0.63 | x | 0.7 | = | 21.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 44.07 | | 0.63 | x | 0.7 | = | 19.39 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (79) |
| 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 | 0.51 | x | 11.28 | x | 0.63 | x | 0.7 | = | 1.76 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 11.28 | x | 0.63 | x | 0.7 | = | 17.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 11.28 | x | 0.63 | x | 0.7 | = | 17.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.51 | x | 22.97 | x | 0.63 | x | 0.7 | = | 3.58 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 22.97 | x | 0.63 | x | 0.7 | = | 35.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 22.97 | x | 0.63 | x | 0.7 | = | 35.38 | (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 | 0.51 | x | 41.38 | x | 0.63 | x | 0.7 | = | 6.45 | (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 | 5.04 | x | 41.38 | x | 0.63 | x | 0.7 | = | 63.74 | (81) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design sta

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 41.38 | x | 0.63 | x | 0.7 | = | 63.74 | (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 | 0.51 | x | 67.96 | x | 0.63 | x | 0.7 | = | 10.59 | (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 | 5.04 | x | 67.96 | x | 0.63 | x | 0.7 | = | 104.67 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 67.96 | x | 0.63 | x | 0.7 | = | 104.67 | (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 | 0.51 | x | 91.35 | x | 0.63 | x | 0.7 | = | 14.24 | (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 | 5.04 | x | 91.35 | x | 0.63 | x | 0.7 | = | 140.7 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 91.35 | x | 0.63 | x | 0.7 | = | 140.7 | (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 | 0.51 | x | 97.38 | x | 0.63 | x | 0.7 | = | 15.18 | (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 | 5.04 | x | 97.38 | x | 0.63 | x | 0.7 | = | 150 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 97.38 | x | 0.63 | x | 0.7 | = | 150 | (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 | 0.51 | x | 91.1 | x | 0.63 | x | 0.7 | = | 14.2 | (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 | 5.04 | x | 91.1 | x | 0.63 | x | 0.7 | = | 140.32 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 91.1 | x | 0.63 | x | 0.7 | = | 140.32 | (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 | 0.51 | x | 72.63 | x | 0.63 | x | 0.7 | = | 11.32 | (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 | 5.04 | x | 72.63 | x | 0.63 | x | 0.7 | = | 111.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 72.63 | x | 0.63 | x | 0.7 | = | 111.87 | (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 | 0.51 | x | 50.42 | x | 0.63 | x | 0.7 | = | 7.86 | (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 | 5.04 | x | 50.42 | x | 0.63 | x | 0.7 | = | 77.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 50.42 | x | 0.63 | x | 0.7 | = | 77.66 | (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 | 0.51 | x | 28.07 | x | 0.63 | x | 0.7 | = | 4.37 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |

# Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design sta

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 28.07 | x | 0.63 | x | 0.7 | = | 43.23 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 28.07 | x | 0.63 | x | 0.7 | = | 43.23 | (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 | 0.51 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.21 | (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 | 5.04 | x | 14.2 | x | 0.63 | x | 0.7 | = | 21.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 14.2 | x | 0.63 | x | 0.7 | = | 21.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.51 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.44 | (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 | 5.04 | x | 9.21 | x | 0.63 | x | 0.7 | = | 14.19 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 9.21 | x | 0.63 | x | 0.7 | = | 14.19 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 185.19 | 333.37 | 503.75 | 703.97 | 861.35 | 887.16 | 841.98 | 719.67 | 572.31 | 381.28 | 225.08 | 156.37 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 644.29 | 791.07 | 945.33 | 1118.71 | 1247.21 | 1246.43 | 1184.74 | 1066.61 | 933.71 | 769.68 | 644.6 | 600.8 | (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 | 0.71 | 0.92 | 0.99 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.44 | 19.6 | 19.89 | 20.28 | 20.65 | 20.89 | 20.97 | 20.95 | 20.75 | 20.27 | 19.79 | 19.41 | (87) |

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.97 | 0.89 | 0.7 | 0.49 | 0.57 | 0.87 | 0.99 | 1 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.42 | 18.59 | 18.88 | 19.28 | 19.62 | 19.83 | 19.87 | 19.87 | 19.72 | 19.27 | 18.78 | 18.41 | (90) |

fLA = Living area ÷ (4) = 0.18 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.61 | 18.78 | 19.06 | 19.46 | 19.81 | 20.02 | 20.08 | 20.07 | 19.91 | 19.46 | 18.97 | 18.59 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.61 | 18.78 | 19.06 | 19.46 | 19.81 | 20.02 | 20.08 | 20.07 | 19.91 | 19.46 | 18.97 | 18.59 | (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 | 0.89 | 0.72 | 0.52 | 0.6 | 0.87 | 0.98 | 1 | 1 | (94) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 643.59 | 788.75 | 936.73 | 1080.99 | 1107.93 | 893.4 | 616.16 | 636.5 | 814.77 | 757.2 | 643.06 | 600.34 | (95) |

Monthly average external temperature from Table 8

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (97)m= | 2681.76 | 2594.02 | 2342.69 | 1945.65 | 1490.81 | 986.1 | 631.89 | 665.53 | 1061.13 | 1627.8 | 2191.21 | 2670.06 | (97) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 1516.39 | 1213.14 | 1046.04 | 622.55 | 284.86 | 0 | 0 | 0 | 0 | 647.72 | 1114.67 | 1539.87 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 7985.25 (98)

Space heating requirement in kWh/m²/year 54.84 (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 | 1708.91 | 1345.31 | 1378.9 | 0 | 0 | 0 | 0 | (100) |
| Utilisation factor for loss hm | | | | | | | | | | | | | |
| (101)m= | 0 | 0 | 0 | 0 | 0 | 0.79 | 0.87 | 0.82 | 0 | 0 | 0 | 0 | (101) |
| Useful loss, hmLm (Watts) = (100)m x (101)m | | | | | | | | | | | | | |
| (102)m= | 0 | 0 | 0 | 0 | 0 | 1352.24 | 1167.62 | 1134.12 | 0 | 0 | 0 | 0 | (102) |
| Gains (solar gains calculated for applicable weather region, see Table 10) | | | | | | | | | | | | | |
| (103)m= | 0 | 0 | 0 | 0 | 0 | 1581.1 | 1506.11 | 1370.44 | 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 | 164.78 | 251.84 | 175.82 | 0 | 0 | 0 | 0 | |

Total = Sum(104)$_{5...8}$ = 592.44 (104)

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

Intermittency factor (Table 10b)

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (107)m= | 0 | 0 | 0 | 0 | 0 | 41.2 | 62.96 | 43.96 | 0 | 0 | 0 | 0 | |

Total = Sum(107)$_{5...8}$ = 148.11 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.02 (108)

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

Fabric Energy Efficiency (99) + (108) = 55.86 (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 8

**Address :** Plot 8 , Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 72.8 (1a) | x | 2.4 (2a) | = | 174.72 | (3a) |
| Ground floor | 72.8 (1b) | x | 2.6 (2b) | = | 189.28 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 145.6 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 364 | (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 | | | | | | | 6 | x 10 = | 60 | (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) = | 60 | ÷ (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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.53 | 0.52 | 0.51 | 0.46 | 0.45 | 0.39 | 0.39 | 0.38 | 0.41 | 0.45 | 0.47 | 0.49 |

*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 | 0.59 | 0.6 | 0.61 | 0.62 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.64 | 0.63 | 0.63 | 0.6 | 0.6 | 0.58 | 0.58 | 0.57 | 0.59 | 0.6 | 0.61 | 0.62 |

(25)

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors Type 1 | | | 2.12 | x | 1.2 | = | 2.544 | | | (26) |
| Doors Type 2 | | | 1.97 | x | 1.2 | = | 2.364 | | | (26) |
| Windows Type 1 | | | 2.39 | x1/[1/( 1.2 )+ 0.04] | | = | 2.74 | | | (27) |
| Windows Type 2 | | | 0.48 | x1/[1/( 1.2 )+ 0.04] | | = | 0.55 | | | (27) |
| Windows Type 3 | | | 0.48 | x1/[1/( 1.2 )+ 0.04] | | = | 0.55 | | | (27) |
| Windows Type 4 | | | 1.62 | x1/[1/( 1.2 )+ 0.04] | | = | 1.85 | | | (27) |
| Windows Type 5 | | | 0.76 | x1/[1/( 1.2 )+ 0.04] | | = | 0.87 | | | (27) |
| Windows Type 6 | | | 0.76 | x1/[1/( 1.2 )+ 0.04] | | = | 0.87 | | | (27) |
| Windows Type 7 | | | 2.12 | x1/[1/( 1.2 )+ 0.04] | | = | 2.43 | | | (27) |
| Windows Type 8 | | | 0.51 | x1/[1/( 1.2 )+ 0.04] | | = | 0.58 | | | (27) |
| Windows Type 9 | | | 0.51 | x1/[1/( 1.2 )+ 0.04] | | = | 0.58 | | | (27) |
| Windows Type 10 | | | 2.12 | x1/[1/( 1.2 )+ 0.04] | | = | 2.43 | | | (27) |
| Windows Type 11 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 12 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |
| Windows Type 13 | | | 0.66 | x1/[1/( 1.2 )+ 0.04] | | = | 0.76 | | | (27) |
| Windows Type 14 | | | 0.51 | x1/[1/( 1.2 )+ 0.04] | | = | 0.58 | | | (27) |
| Windows Type 15 | | | 1.44 | x1/[1/( 1.2 )+ 0.04] | | = | 1.65 | | | (27) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 16 | | | 5.04 | x1/[1/( 1.2 )+ 0.04] = | 5.77 | | | | (27) |
| Windows Type 17 | | | 5.04 | x1/[1/( 1.2 )+ 0.04] = | 5.77 | | | | (27) |
| Floor | | | 72.8 | x 0.12 = | 8.736 | | | | (28) |
| Walls | 173.35 | 31.41 | 141.94 | x 0.24 = | 34.07 | | | | (29) |
| Roof | 72.8 | 0 | 72.8 | x 0.09 = | 6.55 | | | | (30) |
| Total area of elements, m² | | | 318.95 | | | | | | (31) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 85.54 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 14631.6 (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 29.17 (36)

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

Total fabric heat loss (33) + (36) = 114.72 (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= | 76.86 | 76.21 | 75.57 | 72.57 | 72 | 69.39 | 69.39 | 68.9 | 70.4 | 72 | 73.14 | 74.33 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 191.58 | 190.93 | 190.29 | 187.28 | 186.72 | 184.11 | 184.11 | 183.62 | 185.11 | 186.72 | 187.86 | 189.05 | |

Average = Sum(39)$_{1...12}$ /12= 187.28 (39)

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

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

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

Number of days in month (Table 1a)

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

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

Assumed occupancy, N 2.93 (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) + 36 103.72 (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= | 114.09 | 109.94 | 105.79 | 101.64 | 97.49 | 93.35 | 93.35 | 97.49 | 101.64 | 105.79 | 109.94 | 114.09 | |

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

Total = Sum(44)$_{1...12}$ = 1244.62 (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= | 169.19 | 147.98 | 152.7 | 133.13 | 127.74 | 110.23 | 102.14 | 117.21 | 118.61 | 138.23 | 150.89 | 163.85 | |

Total = Sum(45)$_{1...12}$ = 1631.89 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25.38 | 22.2 | 22.9 | 19.97 | 19.16 | 16.53 | 15.32 | 17.58 | 17.79 | 20.73 | 22.63 | 24.58 | (46) |

# DER WorkSheet: New dwelling design stage

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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel: 210 (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) = 210 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day): 0.01 (51)

If community heating see section 4.3

Volume factor from Table 2a: 0.83 (52)

Temperature factor from Table 2b: 0.54 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.13 (54)

Enter (50) or (54) in (55): 1.13 (55)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 34.9 | 31.52 | 34.9 | 33.77 | 34.9 | 33.77 | 34.9 | 34.9 | 33.77 | 34.9 | 33.77 | 34.9 | (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= | 34.9 | 31.52 | 34.9 | 33.77 | 34.9 | 33.77 | 34.9 | 34.9 | 33.77 | 34.9 | 33.77 | 34.9 | (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= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (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= | 227.35 | 200.51 | 210.86 | 189.41 | 185.9 | 166.51 | 160.3 | 175.37 | 174.89 | 196.39 | 207.17 | 222.01 | (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= | 227.35 | 200.51 | 210.86 | 189.41 | 185.9 | 166.51 | 160.3 | 175.37 | 174.89 | 196.39 | 207.17 | 222.01 | |

Output from water heater (annual)$_{1...12}$: 2316.65 (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= | 102.78 | 91.23 | 97.3 | 89.29 | 89 | 81.68 | 80.49 | 85.5 | 84.46 | 92.49 | 95.2 | 101.01 | (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= | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 28.18 | 25.03 | 20.35 | 15.41 | 11.52 | 9.72 | 10.51 | 13.66 | 18.33 | 23.28 | 27.17 | 28.96 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 315.69 | 318.97 | 310.71 | 293.14 | 270.96 | 250.11 | 236.18 | 232.9 | 241.16 | 258.73 | 280.91 | 301.76 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | (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= | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 138.15 | 135.75 | 130.78 | 124.01 | 119.62 | 113.44 | 108.18 | 114.92 | 117.31 | 124.31 | 132.22 | 135.76 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 551.93 | 549.65 | 531.75 | 502.47 | 472 | 443.17 | 424.77 | 431.38 | 446.7 | 476.22 | 510.2 | 536.39 | (73) |

## 6. Solar gains:

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

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast 0.9x | 0.77 | x | 0.76 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 22.97 | x | 0.63 | x | 0.7 | = | 5.33 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 22.97 | x | 0.63 | x | 0.7 | = | 5.33 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 41.38 | x | 0.63 | x | 0.7 | = | 9.61 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 41.38 | x | 0.63 | x | 0.7 | = | 9.61 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 67.96 | x | 0.63 | x | 0.7 | = | 15.78 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 67.96 | x | 0.63 | x | 0.7 | = | 15.78 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.35 | x | 0.63 | x | 0.7 | = | 21.22 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.35 | x | 0.63 | x | 0.7 | = | 21.22 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 97.38 | x | 0.63 | x | 0.7 | = | 22.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 97.38 | x | 0.63 | x | 0.7 | = | 22.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.1 | x | 0.63 | x | 0.7 | = | 21.16 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.1 | x | 0.63 | x | 0.7 | = | 21.16 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 72.63 | x | 0.63 | x | 0.7 | = | 16.87 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 72.63 | x | 0.63 | x | 0.7 | = | 16.87 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 50.42 | x | 0.63 | x | 0.7 | = | 11.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 50.42 | x | 0.63 | x | 0.7 | = | 11.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 28.07 | x | 0.63 | x | 0.7 | = | 6.52 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 28.07 | x | 0.63 | x | 0.7 | = | 6.52 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 14.2 | x | 0.63 | x | 0.7 | = | 3.3 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 14.2 | x | 0.63 | x | 0.7 | = | 3.3 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 9.21 | x | 0.63 | x | 0.7 | = | 2.14 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 9.21 | x | 0.63 | x | 0.7 | = | 2.14 | (75) |
| Southeast 0.9x | 0.77 | x | 2.39 | x | 36.79 | x | 0.63 | x | 0.7 | = | 26.87 | (77) |
| Southeast 0.9x | 0.77 | x | 0.48 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.4 | (77) |

# DER WorkSheet: New dwelling design stage

STUDIO11 architecture

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.4 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 36.79 | x | 0.63 | x | 0.7 | = | 23.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 36.79 | x | 0.63 | x | 0.7 | = | 23.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 62.67 | x | 0.63 | x | 0.7 | = | 45.78 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 62.67 | x | 0.63 | x | 0.7 | = | 40.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.77 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.77 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 62.67 | x | 0.63 | x | 0.7 | = | 40.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 85.75 | x | 0.63 | x | 0.7 | = | 62.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 85.75 | x | 0.63 | x | 0.7 | = | 12.58 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 85.75 | x | 0.63 | x | 0.7 | = | 12.58 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 85.75 | x | 0.63 | x | 0.7 | = | 55.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 85.75 | x | 0.63 | x | 0.7 | = | 13.37 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 85.75 | x | 0.63 | x | 0.7 | = | 13.37 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 85.75 | x | 0.63 | x | 0.7 | = | 55.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 106.25 | x | 0.63 | x | 0.7 | = | 77.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 106.25 | x | 0.63 | x | 0.7 | = | 15.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 106.25 | x | 0.63 | x | 0.7 | = | 15.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 106.25 | x | 0.63 | x | 0.7 | = | 68.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 106.25 | x | 0.63 | x | 0.7 | = | 16.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 106.25 | x | 0.63 | x | 0.7 | = | 16.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 106.25 | x | 0.63 | x | 0.7 | = | 68.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 119.01 | x | 0.63 | x | 0.7 | = | 86.93 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 119.01 | x | 0.63 | x | 0.7 | = | 17.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 119.01 | x | 0.63 | x | 0.7 | = | 17.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 119.01 | x | 0.63 | x | 0.7 | = | 77.11 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 119.01 | x | 0.63 | x | 0.7 | = | 18.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 119.01 | x | 0.63 | x | 0.7 | = | 18.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 119.01 | x | 0.63 | x | 0.7 | = | 77.11 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 118.15 | x | 0.63 | x | 0.7 | = | 86.3 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 118.15 | x | 0.63 | x | 0.7 | = | 17.33 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 118.15 | x | 0.63 | x | 0.7 | = | 17.33 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 118.15 | x | 0.63 | x | 0.7 | = | 76.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 118.15 | x | 0.63 | x | 0.7 | = | 18.42 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 118.15 | x | 0.63 | x | 0.7 | = | 18.42 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 118.15 | x | 0.63 | x | 0.7 | = | 76.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 113.91 | x | 0.63 | x | 0.7 | = | 83.2 | (77) |

# DER WorkSheet: New dwelling design stage

STUDIO11 architecture

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 113.91 | x | 0.63 | x | 0.7 | = | 16.71 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 113.91 | x | 0.63 | x | 0.7 | = | 16.71 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 113.91 | x | 0.63 | x | 0.7 | = | 73.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 113.91 | x | 0.63 | x | 0.7 | = | 17.75 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 113.91 | x | 0.63 | x | 0.7 | = | 17.75 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 113.91 | x | 0.63 | x | 0.7 | = | 73.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 104.39 | x | 0.63 | x | 0.7 | = | 76.25 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 104.39 | x | 0.63 | x | 0.7 | = | 15.31 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 104.39 | x | 0.63 | x | 0.7 | = | 15.31 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 104.39 | x | 0.63 | x | 0.7 | = | 67.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 104.39 | x | 0.63 | x | 0.7 | = | 16.27 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 104.39 | x | 0.63 | x | 0.7 | = | 16.27 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 104.39 | x | 0.63 | x | 0.7 | = | 67.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 92.85 | x | 0.63 | x | 0.7 | = | 67.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 92.85 | x | 0.63 | x | 0.7 | = | 13.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 92.85 | x | 0.63 | x | 0.7 | = | 13.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 92.85 | x | 0.63 | x | 0.7 | = | 60.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 92.85 | x | 0.63 | x | 0.7 | = | 14.47 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 92.85 | x | 0.63 | x | 0.7 | = | 14.47 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 92.85 | x | 0.63 | x | 0.7 | = | 60.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 69.27 | x | 0.63 | x | 0.7 | = | 50.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 69.27 | x | 0.63 | x | 0.7 | = | 44.88 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 69.27 | x | 0.63 | x | 0.7 | = | 44.88 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 44.07 | x | 0.63 | x | 0.7 | = | 32.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 44.07 | x | 0.63 | x | 0.7 | = | 28.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.87 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.87 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 44.07 | x | 0.63 | x | 0.7 | = | 28.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 31.49 | x | 0.63 | x | 0.7 | = | 23 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 31.49 | x | 0.63 | x | 0.7 | = | 20.4 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.91 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.91 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 31.49 | x | 0.63 | x | 0.7 | = | 20.4 | (77) |

# DER WorkSheet: New dwelling design stage

STUDIO11 architecture

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 119.01 | | 0.63 | x | 0.7 | = | 58.92 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 119.01 | | 0.63 | x | 0.7 | = | 52.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 118.15 | | 0.63 | x | 0.7 | = | 58.5 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 118.15 | | 0.63 | x | 0.7 | = | 52 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 113.91 | | 0.63 | x | 0.7 | = | 56.4 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 113.91 | | 0.63 | x | 0.7 | = | 50.13 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 104.39 | | 0.63 | x | 0.7 | = | 51.68 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 104.39 | | 0.63 | x | 0.7 | = | 45.94 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 92.85 | | 0.63 | x | 0.7 | = | 45.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 92.85 | | 0.63 | x | 0.7 | = | 40.86 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 69.27 | | 0.63 | x | 0.7 | = | 34.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 69.27 | | 0.63 | x | 0.7 | = | 30.48 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 44.07 | | 0.63 | x | 0.7 | = | 21.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 44.07 | | 0.63 | x | 0.7 | = | 19.39 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (79) |
| 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 | 0.51 | x | 11.28 | x | 0.63 | x | 0.7 | = | 1.76 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 11.28 | x | 0.63 | x | 0.7 | = | 17.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 11.28 | x | 0.63 | x | 0.7 | = | 17.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.51 | x | 22.97 | x | 0.63 | x | 0.7 | = | 3.58 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 22.97 | x | 0.63 | x | 0.7 | = | 35.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 22.97 | x | 0.63 | x | 0.7 | = | 35.38 | (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 | 0.51 | x | 41.38 | x | 0.63 | x | 0.7 | = | 6.45 | (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 | 5.04 | x | 41.38 | x | 0.63 | x | 0.7 | = | 63.74 | (81) |

# DER WorkSheet: New dwelling design stage

STUDIO11 architecture

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 41.38 | x | 0.63 | x | 0.7 | = | 63.74 | (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 | 0.51 | x | 67.96 | x | 0.63 | x | 0.7 | = | 10.59 | (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 | 5.04 | x | 67.96 | x | 0.63 | x | 0.7 | = | 104.67 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 67.96 | x | 0.63 | x | 0.7 | = | 104.67 | (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 | 0.51 | x | 91.35 | x | 0.63 | x | 0.7 | = | 14.24 | (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 | 5.04 | x | 91.35 | x | 0.63 | x | 0.7 | = | 140.7 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 91.35 | x | 0.63 | x | 0.7 | = | 140.7 | (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 | 0.51 | x | 97.38 | x | 0.63 | x | 0.7 | = | 15.18 | (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 | 5.04 | x | 97.38 | x | 0.63 | x | 0.7 | = | 150 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 97.38 | x | 0.63 | x | 0.7 | = | 150 | (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 | 0.51 | x | 91.1 | x | 0.63 | x | 0.7 | = | 14.2 | (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 | 5.04 | x | 91.1 | x | 0.63 | x | 0.7 | = | 140.32 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 91.1 | x | 0.63 | x | 0.7 | = | 140.32 | (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 | 0.51 | x | 72.63 | x | 0.63 | x | 0.7 | = | 11.32 | (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 | 5.04 | x | 72.63 | x | 0.63 | x | 0.7 | = | 111.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 72.63 | x | 0.63 | x | 0.7 | = | 111.87 | (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 | 0.51 | x | 50.42 | x | 0.63 | x | 0.7 | = | 7.86 | (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 | 5.04 | x | 50.42 | x | 0.63 | x | 0.7 | = | 77.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 50.42 | x | 0.63 | x | 0.7 | = | 77.66 | (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 | 0.51 | x | 28.07 | x | 0.63 | x | 0.7 | = | 4.37 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 28.07 | x | 0.63 | x | 0.7 | = | 43.23 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 28.07 | x | 0.63 | x | 0.7 | = | 43.23 | (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 | 0.51 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.21 | (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 | 5.04 | x | 14.2 | x | 0.63 | x | 0.7 | = | 21.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 14.2 | x | 0.63 | x | 0.7 | = | 21.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.51 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.44 | (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 | 5.04 | x | 9.21 | x | 0.63 | x | 0.7 | = | 14.19 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 9.21 | x | 0.63 | x | 0.7 | = | 14.19 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 185.19 | 333.37 | 503.75 | 703.97 | 861.35 | 887.16 | 841.98 | 719.67 | 572.31 | 381.28 | 225.08 | 156.37 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 737.11 | 883.03 | 1035.5 | 1206.44 | 1333.35 | 1330.33 | 1266.75 | 1151.05 | 1019.01 | 857.51 | 735.28 | 692.76 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.97 | 0.91 | 0.77 | 0.61 | 0.68 | 0.9 | 0.99 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.46 | 19.63 | 19.91 | 20.31 | 20.67 | 20.9 | 20.98 | 20.96 | 20.77 | 20.31 | 19.82 | 19.44 | (87) |

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.96 | 0.87 | 0.67 | 0.47 | 0.54 | 0.84 | 0.98 | 1 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.78 | 18.02 | 18.45 | 19.03 | 19.52 | 19.8 | 19.86 | 19.85 | 19.67 | 19.04 | 18.32 | 17.76 | (90) |

fLA = Living area ÷ (4) = 0.18 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.09 | 18.32 | 18.72 | 19.27 | 19.73 | 20 | 20.06 | 20.06 | 19.87 | 19.27 | 18.59 | 18.07 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.94 | 18.17 | 18.57 | 19.12 | 19.58 | 19.85 | 19.91 | 19.91 | 19.72 | 19.12 | 18.44 | 17.92 | (93) |

## 8. Space heating requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.99 | 0.95 | 0.86 | 0.67 | 0.47 | 0.54 | 0.83 | 0.97 | 1 | 1 | (94) |

# DER WorkSheet: New dwelling design stage

STUDIO11 architecture

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 735.37 | 878.16 | 1020.04 | 1148.63 | 1146.49 | 895.83 | 599.62 | 624.52 | 847.15 | 833.88 | 731.62 | 691.54 |

(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= | 2612.23 | 2533.27 | 2296.11 | 1913.48 | 1472.07 | 967.39 | 610.3 | 644.09 | 1040.85 | 1590.91 | 2131.08 | 2593.39 |

(97)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 1396.38 | 1112.24 | 949.39 | 550.69 | 242.23 | 0 | 0 | 0 | 0 | 563.23 | 1007.61 | 1414.98 |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 7236.75 (98)

Space heating requirement in kWh/m²/year 49.7 (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 (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) | 1396.38 | 1112.24 | 949.39 | 550.69 | 242.23 | 0 | 0 | 0 | 0 | 563.23 | 1007.61 | 1414.98 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) (211) | 1551.53 | 1235.82 | 1054.88 | 611.88 | 269.15 | 0 | 0 | 0 | 0 | 625.81 | 1119.57 | 1572.2 | |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 8040.84 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

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

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

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 227.35 | 200.51 | 210.86 | 189.41 | 185.9 | 166.51 | 160.3 | 175.37 | 174.89 | 196.39 | 207.17 | 222.01 |

Efficiency of water heater 79.3 (216)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 88.33 | 88.18 | 87.85 | 87 | 85.02 | 79.3 | 79.3 | 79.3 | 79.3 | 86.97 | 87.98 | 88.38 |

(217)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 257.38 | 227.38 | 240.03 | 217.72 | 218.65 | 209.97 | 202.14 | 221.14 | 220.54 | 225.82 | 235.48 | 251.19 |

Total = Sum(219a)$_{1...12}$ = 2727.46 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 8040.84 |
| Water heating fuel used | | 2727.46 |
| Electricity for pumps, fans and electric keep-hot | | |
| central heating pump: | 30 | (230c) |

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| boiler with a fan-assisted flue | | 45 | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | 75 | (231) |
| Electricity for lighting | | 497.6 | (232) |
| Electricity generated by PVs | | -1204.8 | (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 | = | 1736.82 | (261) |
| Space heating (secondary) | (215) x | | 0.519 | = | 0 | (263) |
| Water heating | (219) x | | 0.216 | = | 589.13 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 2325.95 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | | 0.519 | = | 258.26 | (268) |
| Energy saving/generation technologies Item 1 | | | 0.519 | = | -625.29 | (269) |
| Total CO2, kg/year | | sum of (265)…(271) = | | | 1997.84 | (272) |
| **Dwelling CO2 Emission Rate** | | (272) ÷ (4) = | | | 13.72 | (273) |
| EI rating (section 14) | | | | | 86 | (274) |

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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 8

**Address :** Plot 8 , Land off Wardentree Lane, Spalding

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 72.8 (1a) | x | 2.4 (2a) | = | 174.72 | (3a) |
| Ground floor | 72.8 (1b) | x | 2.6 (2b) | = | 189.28 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 145.6 (4) | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 364 | (5) |

## 2. Ventilation rate:

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

| | | | Air changes per hour | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.11 (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) | | 0.36 (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) = | | 0.36 (21) |

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

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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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.46 | 0.45 | 0.44 | 0.4 | 0.39 | 0.34 | 0.34 | 0.33 | 0.36 | 0.39 | 0.4 | 0.42 |

*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= | 0.61 | 0.6 | 0.6 | 0.58 | 0.57 | 0.56 | 0.56 | 0.56 | 0.56 | 0.57 | 0.58 | 0.59 | (24d) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.61 | 0.6 | 0.6 | 0.58 | 0.57 | 0.56 | 0.56 | 0.56 | 0.56 | 0.57 | 0.58 | 0.59 | (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 Type 1 | | | 2.12 | x | 1.2 | = | 2.544 | | | (26) |
| Doors Type 2 | | | 1.97 | x | 1.2 | = | 2.364 | | | (26) |
| Windows Type 1 | | | 2.39 | x1/[1/( 1.4 )+ 0.04] | | = | 3.17 | | | (27) |
| Windows Type 2 | | | 0.48 | x1/[1/( 1.4 )+ 0.04] | | = | 0.64 | | | (27) |
| Windows Type 3 | | | 0.48 | x1/[1/( 1.4 )+ 0.04] | | = | 0.64 | | | (27) |
| Windows Type 4 | | | 1.62 | x1/[1/( 1.4 )+ 0.04] | | = | 2.15 | | | (27) |
| Windows Type 5 | | | 0.76 | x1/[1/( 1.4 )+ 0.04] | | = | 1.01 | | | (27) |
| Windows Type 6 | | | 0.76 | x1/[1/( 1.4 )+ 0.04] | | = | 1.01 | | | (27) |
| Windows Type 7 | | | 2.12 | x1/[1/( 1.4 )+ 0.04] | | = | 2.81 | | | (27) |
| Windows Type 8 | | | 0.51 | x1/[1/( 1.4 )+ 0.04] | | = | 0.68 | | | (27) |
| Windows Type 9 | | | 0.51 | x1/[1/( 1.4 )+ 0.04] | | = | 0.68 | | | (27) |
| Windows Type 10 | | | 2.12 | x1/[1/( 1.4 )+ 0.04] | | = | 2.81 | | | (27) |
| Windows Type 11 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 12 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |
| Windows Type 13 | | | 0.66 | x1/[1/( 1.4 )+ 0.04] | | = | 0.88 | | | (27) |
| Windows Type 14 | | | 0.51 | x1/[1/( 1.4 )+ 0.04] | | = | 0.68 | | | (27) |
| Windows Type 15 | | | 1.44 | x1/[1/( 1.4 )+ 0.04] | | = | 1.91 | | | (27) |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 16 | | | 5.04 | x1/[1/( 1.4 )+ 0.04] = | 6.68 | | | | (27) |
| Windows Type 17 | | | 5.04 | x1/[1/( 1.4 )+ 0.04] = | 6.68 | | | | (27) |
| Floor | | | 72.8 | x | 0.13 | = | 9.464 | | (28) |
| Walls | 173.35 | 31.41 | 141.94 | x | 0.18 | = | 25.55 | | (29) |
| Roof | 72.8 | 0 | 72.8 | x | 0.13 | = | 9.46 | | (30) |
| Total area of elements, m² | | | 318.95 | | | | | | (31) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 85.6 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 14631.6 (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 14.08 (36)

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

Total fabric heat loss (33) + (36) = 99.69 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 72.71 | 72.21 | 71.73 | 69.47 | 69.05 | 67.08 | 67.08 | 66.72 | 67.84 | 69.05 | 69.91 | 70.8 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 172.39 | 171.9 | 171.42 | 169.16 | 168.74 | 166.77 | 166.77 | 166.4 | 167.53 | 168.74 | 169.59 | 170.49 | |

Average = Sum(39)$_{1...12}$ /12= 169.16 (39)

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

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

Average = Sum(40)$_{1...12}$ /12= 1.16 (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 2.93 (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) + 36 103.72 (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= | 114.09 | 109.94 | 105.79 | 101.64 | 97.49 | 93.35 | 93.35 | 97.49 | 101.64 | 105.79 | 109.94 | 114.09 | |

Total = Sum(44)$_{1...12}$ = 1244.62 (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= | 169.19 | 147.98 | 152.7 | 133.13 | 127.74 | 110.23 | 102.14 | 117.21 | 118.61 | 138.23 | 150.89 | 163.85 | |

Total = Sum(45)$_{1...12}$ = 1631.89 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25.38 | 22.2 | 22.9 | 19.97 | 19.16 | 16.53 | 15.32 | 17.58 | 17.79 | 20.73 | 22.63 | 24.58 | (46) |

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Water storage loss:

| | | | |
|---|---|---|---|
| Storage volume (litres) including any solar or WWHRS storage within same vessel | | 150 | (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): | | 1.7 | (48) |
| Temperature factor from Table 2b | | 0.54 | (49) |
| Energy lost from water storage, kWh/year | (48) x (49) = | 0.92 | (50) |
| b) If manufacturer's declared cylinder loss factor is not known: | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | 0 | (51) |
| If community heating see section 4.3 | | | |
| Volume factor from Table 2a | | 0 | (52) |
| Temperature factor from Table 2b | | 0 | (53) |
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 0 | (54) |
| Enter (50) or (54) in (55) | | 0.92 | (55) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 28.48 | 25.73 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 | (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= | 28.48 | 25.73 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 | (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= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (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= | 220.94 | 194.72 | 204.44 | 183.2 | 179.48 | 160.31 | 153.89 | 168.96 | 168.69 | 189.97 | 200.96 | 215.6 | (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= | 220.94 | 194.72 | 204.44 | 183.2 | 179.48 | 160.31 | 153.89 | 168.96 | 168.69 | 189.97 | 200.96 | 215.6 | |

Output from water heater (annual)$_{1...12}$ 2241.16 (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= | 97.65 | 86.59 | 92.17 | 84.33 | 83.87 | 76.71 | 75.36 | 80.37 | 79.5 | 87.36 | 90.23 | 95.88 | (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= | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | 146.35 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 28.18 | 25.03 | 20.35 | 15.41 | 11.52 | 9.72 | 10.51 | 13.66 | 18.33 | 23.28 | 27.17 | 28.96 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 315.69 | 318.97 | 310.71 | 293.14 | 270.96 | 250.11 | 236.18 | 232.9 | 241.16 | 258.73 | 280.91 | 301.76 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | 37.64 | (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= | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | -117.08 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 131.25 | 128.86 | 123.88 | 117.12 | 112.73 | 106.55 | 101.29 | 108.02 | 110.42 | 117.42 | 125.32 | 128.87 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 545.03 | 542.76 | 524.86 | 495.57 | 465.11 | 436.28 | 417.88 | 424.49 | 439.81 | 469.33 | 503.31 | 529.5 | (73) |

## 6. Solar gains:

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

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast 0.9x | 0.77 | x | 0.76 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 22.97 | x | 0.63 | x | 0.7 | = | 5.33 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 22.97 | x | 0.63 | x | 0.7 | = | 5.33 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 41.38 | x | 0.63 | x | 0.7 | = | 9.61 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 41.38 | x | 0.63 | x | 0.7 | = | 9.61 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 67.96 | x | 0.63 | x | 0.7 | = | 15.78 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 67.96 | x | 0.63 | x | 0.7 | = | 15.78 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.35 | x | 0.63 | x | 0.7 | = | 21.22 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.35 | x | 0.63 | x | 0.7 | = | 21.22 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 97.38 | x | 0.63 | x | 0.7 | = | 22.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 97.38 | x | 0.63 | x | 0.7 | = | 22.62 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.1 | x | 0.63 | x | 0.7 | = | 21.16 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 91.1 | x | 0.63 | x | 0.7 | = | 21.16 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 72.63 | x | 0.63 | x | 0.7 | = | 16.87 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 72.63 | x | 0.63 | x | 0.7 | = | 16.87 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 50.42 | x | 0.63 | x | 0.7 | = | 11.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 50.42 | x | 0.63 | x | 0.7 | = | 11.71 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 28.07 | x | 0.63 | x | 0.7 | = | 6.52 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 28.07 | x | 0.63 | x | 0.7 | = | 6.52 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 14.2 | x | 0.63 | x | 0.7 | = | 3.3 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 14.2 | x | 0.63 | x | 0.7 | = | 3.3 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 9.21 | x | 0.63 | x | 0.7 | = | 2.14 | (75) |
| Northeast 0.9x | 0.77 | x | 0.76 | x | 9.21 | x | 0.63 | x | 0.7 | = | 2.14 | (75) |
| Southeast 0.9x | 0.77 | x | 2.39 | x | 36.79 | x | 0.63 | x | 0.7 | = | 26.87 | (77) |
| Southeast 0.9x | 0.77 | x | 0.48 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.4 | (77) |

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.4 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 36.79 | x | 0.63 | x | 0.7 | = | 23.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 36.79 | x | 0.63 | x | 0.7 | = | 5.73 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 36.79 | x | 0.63 | x | 0.7 | = | 23.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 62.67 | x | 0.63 | x | 0.7 | = | 45.78 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 62.67 | x | 0.63 | x | 0.7 | = | 40.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.77 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 62.67 | x | 0.63 | x | 0.7 | = | 9.77 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 62.67 | x | 0.63 | x | 0.7 | = | 40.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 85.75 | x | 0.63 | x | 0.7 | = | 62.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 85.75 | x | 0.63 | x | 0.7 | = | 12.58 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 85.75 | x | 0.63 | x | 0.7 | = | 12.58 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 85.75 | x | 0.63 | x | 0.7 | = | 55.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 85.75 | x | 0.63 | x | 0.7 | = | 13.37 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 85.75 | x | 0.63 | x | 0.7 | = | 13.37 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 85.75 | x | 0.63 | x | 0.7 | = | 55.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 106.25 | x | 0.63 | x | 0.7 | = | 77.61 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 106.25 | x | 0.63 | x | 0.7 | = | 15.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 106.25 | x | 0.63 | x | 0.7 | = | 15.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 106.25 | x | 0.63 | x | 0.7 | = | 68.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 106.25 | x | 0.63 | x | 0.7 | = | 16.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 106.25 | x | 0.63 | x | 0.7 | = | 16.56 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 106.25 | x | 0.63 | x | 0.7 | = | 68.84 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 119.01 | x | 0.63 | x | 0.7 | = | 86.93 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 119.01 | x | 0.63 | x | 0.7 | = | 17.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 119.01 | x | 0.63 | x | 0.7 | = | 17.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 119.01 | x | 0.63 | x | 0.7 | = | 77.11 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 119.01 | x | 0.63 | x | 0.7 | = | 18.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 119.01 | x | 0.63 | x | 0.7 | = | 18.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 119.01 | x | 0.63 | x | 0.7 | = | 77.11 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 118.15 | x | 0.63 | x | 0.7 | = | 86.3 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 118.15 | x | 0.63 | x | 0.7 | = | 17.33 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 118.15 | x | 0.63 | x | 0.7 | = | 17.33 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 118.15 | x | 0.63 | x | 0.7 | = | 76.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 118.15 | x | 0.63 | x | 0.7 | = | 18.42 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 118.15 | x | 0.63 | x | 0.7 | = | 18.42 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 118.15 | x | 0.63 | x | 0.7 | = | 76.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 113.91 | x | 0.63 | x | 0.7 | = | 83.2 | (77) |

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| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 113.91 | x | 0.63 | x | 0.7 | = | 16.71 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 113.91 | x | 0.63 | x | 0.7 | = | 16.71 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 113.91 | x | 0.63 | x | 0.7 | = | 73.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 113.91 | x | 0.63 | x | 0.7 | = | 17.75 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 113.91 | x | 0.63 | x | 0.7 | = | 17.75 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 113.91 | x | 0.63 | x | 0.7 | = | 73.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 104.39 | x | 0.63 | x | 0.7 | = | 76.25 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 104.39 | x | 0.63 | x | 0.7 | = | 15.31 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 104.39 | x | 0.63 | x | 0.7 | = | 15.31 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 104.39 | x | 0.63 | x | 0.7 | = | 67.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 104.39 | x | 0.63 | x | 0.7 | = | 16.27 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 104.39 | x | 0.63 | x | 0.7 | = | 16.27 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 104.39 | x | 0.63 | x | 0.7 | = | 67.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 92.85 | x | 0.63 | x | 0.7 | = | 67.82 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 92.85 | x | 0.63 | x | 0.7 | = | 13.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 92.85 | x | 0.63 | x | 0.7 | = | 13.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 92.85 | x | 0.63 | x | 0.7 | = | 60.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 92.85 | x | 0.63 | x | 0.7 | = | 14.47 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 92.85 | x | 0.63 | x | 0.7 | = | 14.47 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 92.85 | x | 0.63 | x | 0.7 | = | 60.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 69.27 | x | 0.63 | x | 0.7 | = | 50.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.16 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 69.27 | x | 0.63 | x | 0.7 | = | 44.88 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 69.27 | x | 0.63 | x | 0.7 | = | 10.8 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 69.27 | x | 0.63 | x | 0.7 | = | 44.88 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 44.07 | x | 0.63 | x | 0.7 | = | 32.19 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.46 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 44.07 | x | 0.63 | x | 0.7 | = | 28.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.87 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 44.07 | x | 0.63 | x | 0.7 | = | 6.87 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 44.07 | x | 0.63 | x | 0.7 | = | 28.55 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.39 | x | 31.49 | x | 0.63 | x | 0.7 | = | 23 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.48 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.62 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 31.49 | x | 0.63 | x | 0.7 | = | 20.4 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.91 | (77) |
| Southeast | 0.9x | 0.77 | x | 0.51 | x | 31.49 | x | 0.63 | x | 0.7 | = | 4.91 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.12 | x | 31.49 | x | 0.63 | x | 0.7 | = | 20.4 | (77) |

# TER WorkSheet: New dwelling design stage

STUDIO11 architecture

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 36.79 | | 0.63 | x | 0.7 | = | 18.22 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.19 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 62.67 | | 0.63 | x | 0.7 | = | 31.03 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.58 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 85.75 | | 0.63 | x | 0.7 | = | 42.46 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 85.75 | | 0.63 | x | 0.7 | = | 37.74 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 106.25 | | 0.63 | x | 0.7 | = | 52.6 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 106.25 | | 0.63 | x | 0.7 | = | 46.76 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 119.01 | | 0.63 | x | 0.7 | = | 58.92 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 119.01 | | 0.63 | x | 0.7 | = | 52.37 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 118.15 | | 0.63 | x | 0.7 | = | 58.5 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 118.15 | | 0.63 | x | 0.7 | = | 52 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 113.91 | | 0.63 | x | 0.7 | = | 56.4 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 113.91 | | 0.63 | x | 0.7 | = | 50.13 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 104.39 | | 0.63 | x | 0.7 | = | 51.68 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 104.39 | | 0.63 | x | 0.7 | = | 45.94 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 92.85 | | 0.63 | x | 0.7 | = | 45.97 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 92.85 | | 0.63 | x | 0.7 | = | 40.86 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 69.27 | | 0.63 | x | 0.7 | = | 34.29 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 69.27 | | 0.63 | x | 0.7 | = | 30.48 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 44.07 | | 0.63 | x | 0.7 | = | 21.82 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 44.07 | | 0.63 | x | 0.7 | = | 19.39 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.62 | x | 31.49 | | 0.63 | x | 0.7 | = | 15.59 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.44 | x | 31.49 | | 0.63 | x | 0.7 | = | 13.86 | (79) |
| 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 | 0.51 | x | 11.28 | x | 0.63 | x | 0.7 | = | 1.76 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.97 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 11.28 | x | 0.63 | x | 0.7 | = | 17.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 11.28 | x | 0.63 | x | 0.7 | = | 17.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.66 | x | 22.97 | x | 0.63 | x | 0.7 | = | 4.63 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.51 | x | 22.97 | x | 0.63 | x | 0.7 | = | 3.58 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.11 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 22.97 | x | 0.63 | x | 0.7 | = | 35.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 22.97 | x | 0.63 | x | 0.7 | = | 35.38 | (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 | 0.51 | x | 41.38 | x | 0.63 | x | 0.7 | = | 6.45 | (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 | 5.04 | x | 41.38 | x | 0.63 | x | 0.7 | = | 63.74 | (81) |

# TER WorkSheet: New dwelling design stage

STUDIO11 architecture

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 41.38 | x | 0.63 | x | 0.7 | = | 63.74 | (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 | 0.51 | x | 67.96 | x | 0.63 | x | 0.7 | = | 10.59 | (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 | 5.04 | x | 67.96 | x | 0.63 | x | 0.7 | = | 104.67 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 67.96 | x | 0.63 | x | 0.7 | = | 104.67 | (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 | 0.51 | x | 91.35 | x | 0.63 | x | 0.7 | = | 14.24 | (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 | 5.04 | x | 91.35 | x | 0.63 | x | 0.7 | = | 140.7 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 91.35 | x | 0.63 | x | 0.7 | = | 140.7 | (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 | 0.51 | x | 97.38 | x | 0.63 | x | 0.7 | = | 15.18 | (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 | 5.04 | x | 97.38 | x | 0.63 | x | 0.7 | = | 150 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 97.38 | x | 0.63 | x | 0.7 | = | 150 | (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 | 0.51 | x | 91.1 | x | 0.63 | x | 0.7 | = | 14.2 | (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 | 5.04 | x | 91.1 | x | 0.63 | x | 0.7 | = | 140.32 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 91.1 | x | 0.63 | x | 0.7 | = | 140.32 | (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 | 0.51 | x | 72.63 | x | 0.63 | x | 0.7 | = | 11.32 | (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 | 5.04 | x | 72.63 | x | 0.63 | x | 0.7 | = | 111.87 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 72.63 | x | 0.63 | x | 0.7 | = | 111.87 | (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 | 0.51 | x | 50.42 | x | 0.63 | x | 0.7 | = | 7.86 | (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 | 5.04 | x | 50.42 | x | 0.63 | x | 0.7 | = | 77.66 | (81) |
| Northwest | 0.9x | 0.77 | x | 5.04 | x | 50.42 | x | 0.63 | x | 0.7 | = | 77.66 | (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 | 0.51 | x | 28.07 | x | 0.63 | x | 0.7 | = | 4.37 | (81) |
| Northwest | 0.9x | 0.77 | x | 1.44 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.35 | (81) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest 0.9x | 0.77 | x | 5.04 | x | 28.07 | x | 0.63 | x | 0.7 | = | 43.23 | (81) |
| Northwest 0.9x | 0.77 | x | 5.04 | x | 28.07 | x | 0.63 | x | 0.7 | = | 43.23 | (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 | 0.51 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.21 | (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 | 5.04 | x | 14.2 | x | 0.63 | x | 0.7 | = | 21.87 | (81) |
| Northwest 0.9x | 0.77 | x | 5.04 | x | 14.2 | x | 0.63 | x | 0.7 | = | 21.87 | (81) |
| Northwest 0.9x | 0.77 | x | 1.44 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.06 | (81) |
| Northwest 0.9x | 0.77 | x | 0.66 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.86 | (81) |
| Northwest 0.9x | 0.77 | x | 0.51 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.44 | (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 | 5.04 | x | 9.21 | x | 0.63 | x | 0.7 | = | 14.19 | (81) |
| Northwest 0.9x | 0.77 | x | 5.04 | x | 9.21 | x | 0.63 | x | 0.7 | = | 14.19 | (81) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 185.19 | 333.37 | 503.75 | 703.97 | 861.35 | 887.16 | 841.98 | 719.67 | 572.31 | 381.28 | 225.08 | 156.37 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 730.22 | 876.13 | 1028.6 | 1199.54 | 1326.45 | 1323.44 | 1259.86 | 1144.16 | 1012.12 | 850.61 | 728.39 | 685.87 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.97 | 0.89 | 0.73 | 0.57 | 0.64 | 0.88 | 0.99 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.62 | 19.79 | 20.06 | 20.43 | 20.75 | 20.94 | 20.99 | 20.98 | 20.83 | 20.41 | 19.95 | 19.6 | (87) |

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.96 | 0.85 | 0.64 | 0.44 | 0.51 | 0.82 | 0.98 | 1 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.09 | 18.33 | 18.73 | 19.27 | 19.71 | 19.92 | 19.96 | 19.96 | 19.82 | 19.25 | 18.58 | 18.06 | (90) |

fLA = Living area ÷ (4) = 0.18 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.37 | 18.6 | 18.97 | 19.49 | 19.9 | 20.11 | 20.15 | 20.14 | 20 | 19.46 | 18.83 | 18.35 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.37 | 18.6 | 18.97 | 19.49 | 19.9 | 20.11 | 20.15 | 20.14 | 20 | 19.46 | 18.83 | 18.35 | (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 | 0.95 | 0.85 | 0.66 | 0.46 | 0.53 | 0.82 | 0.97 | 1 | 1 | (94) |

# TER WorkSheet: New dwelling design stage

STUDIO11 architecture

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 728.81 | 871.88 | 1013.97 | 1140.41 | 1127.8 | 868.6 | 584.7 | 609.48 | 834.24 | 827.95 | 725.27 | 684.9 |

(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= | 2425.55 | 2354.4 | 2138.39 | 1790.58 | 1383.53 | 918.74 | 591.72 | 622.99 | 989.1 | 1495.54 | 1989.69 | 2411.61 |

(97)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 1262.37 | 996.25 | 836.57 | 468.12 | 190.26 | 0 | 0 | 0 | 0 | 496.69 | 910.38 | 1284.67 |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 6445.32 (98)

Space heating requirement in kWh/m²/year 44.27 (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 93.5 (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) | 1262.37 | 996.25 | 836.57 | 468.12 | 190.26 | 0 | 0 | 0 | 0 | 496.69 | 910.38 | 1284.67 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 1350.13 | 1065.51 | 894.73 | 500.66 | 203.49 | 0 | 0 | 0 | 0 | 531.22 | 973.67 | 1373.98 | (211) |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 6893.39 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

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

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

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 220.94 | 194.72 | 204.44 | 183.2 | 179.48 | 160.31 | 153.89 | 168.96 | 168.69 | 189.97 | 200.96 | 215.6 |

Efficiency of water heater 79.8 (216)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 88.73 | 88.56 | 88.18 | 87.21 | 84.97 | 79.8 | 79.8 | 79.8 | 79.8 | 87.26 | 88.36 | 88.79 |

(217)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 249.01 | 219.87 | 231.85 | 210.07 | 211.23 | 200.88 | 192.84 | 211.72 | 211.39 | 217.7 | 227.44 | 242.82 |

Total = Sum(219a)$_{1...12}$ = 2626.85 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 6893.39 |
| Water heating fuel used | | 2626.85 |
| Electricity for pumps, fans and electric keep-hot | | |
| central heating pump: | 30 | (230c) |

# TER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| boiler with a fan-assisted flue | | 45 | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | 75 | (231) |
| Electricity for lighting | | 497.6 | (232) |

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

| | Energy kWh/year | | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | | 0.216 | = | 1488.97 | (261) |
| Space heating (secondary) | (215) x | | 0.519 | = | 0 | (263) |
| Water heating | (219) x | | 0.216 | = | 567.4 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 2056.37 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | | 0.519 | = | 258.26 | (268) |
| Total CO2, kg/year | sum of (265)…(271) = | | | | 2353.55 | (272) |

**TER =** 16.16 (273)

# SAP 2012 Overheating Assessment

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

STUDIO11 architecture

## Property Details: Plot 8

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

## Overheating Details:

| | | |
|---|---|---|
| **Summer ventilation heat loss coefficient:** | 360.36 | **(P1)** |
| **Transmission heat loss coefficient:** | 114.7 | |
| **Summer heat loss coefficient:** | 475.08 | **(P2)** |

## Overhangs:

| Orientation: | Ratio: | Z_overhangs: |
|---|---|---|
| South East (W1) | 0 | 1 |
| South East (W2) | 0 | 1 |
| South East (W3) | 0 | 1 |
| South West (W5) | 0 | 1 |
| North East (W6) | 0 | 1 |
| North East (W7) | 0 | 1 |
| South East (W8) | 0 | 1 |
| South East (W9) | 0 | 1 |
| South East (W10) | 0 | 1 |
| South East (W11) | 0 | 1 |
| South West (W12) | 0 | 1 |
| North West (W13) | 0 | 1 |
| North West (W14) | 0 | 1 |
| North West (W15) | 0 | 1 |
| North West (W16) | 0 | 1 |
| North West (D3) | 0 | 1 |
| North West (D4) | 0 | 1 |

## Solar shading:

| Orientation: | Z blinds: | Solar access: | Overhangs: | Z summer: | |
|---|---|---|---|---|---|
| South East (W1) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South East (W2) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South East (W3) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South West (W5) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North East (W6) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North East (W7) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South East (W8) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South East (W9) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South East (W10) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| South East (W11) | 1 | 0.9 | 1 | 0.9 | **(P8)** |

# SAP 2012 Overheating Assessment

| | | | | | |
|---|---|---|---|---|---|
| South West (W12) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (W13) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (W14) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (W15) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (W16) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (D3) | 1 | 0.9 | 1 | 0.9 | **(P8)** |
| North West (D4) | 1 | 0.9 | 1 | 0.9 | **(P8)** |

## Solar gains:

| **Orientation** | | **Area** | **Flux** | **g_** | **FF** | **Shading** | **Gains** | |
|---|---|---|---|---|---|---|---|---|
| South East (W1) | 0.9 x | 2.39 | 113.91 | 0.63 | 0.7 | 0.9 | 97.25 | |
| South East (W2) | 0.9 x | 0.48 | 113.91 | 0.63 | 0.7 | 0.9 | 19.53 | |
| South East (W3) | 0.9 x | 0.48 | 113.91 | 0.63 | 0.7 | 0.9 | 19.53 | |
| South West (W5) | 0.9 x | 1.62 | 113.91 | 0.63 | 0.7 | 0.9 | 65.92 | |
| North East (W6) | 0.9 x | 0.76 | 91.1 | 0.63 | 0.7 | 0.9 | 24.73 | |
| North East (W7) | 0.9 x | 0.76 | 91.1 | 0.63 | 0.7 | 0.9 | 24.73 | |
| South East (W8) | 0.9 x | 2.12 | 113.91 | 0.63 | 0.7 | 0.9 | 86.26 | |
| South East (W9) | 0.9 x | 0.51 | 113.91 | 0.63 | 0.7 | 0.9 | 20.75 | |
| South East (W10) | 0.9 x | 0.51 | 113.91 | 0.63 | 0.7 | 0.9 | 20.75 | |
| South East (W11) | 0.9 x | 2.12 | 113.91 | 0.63 | 0.7 | 0.9 | 86.26 | |
| South West (W12) | 0.9 x | 1.44 | 113.91 | 0.63 | 0.7 | 0.9 | 58.59 | |
| North West (W13) | 0.9 x | 1.44 | 91.1 | 0.63 | 0.7 | 0.9 | 46.86 | |
| North West (W14) | 0.9 x | 0.66 | 91.1 | 0.63 | 0.7 | 0.9 | 21.48 | |
| North West (W15) | 0.9 x | 0.51 | 91.1 | 0.63 | 0.7 | 0.9 | 16.6 | |
| North West (W16) | 0.9 x | 1.44 | 91.1 | 0.63 | 0.7 | 0.9 | 46.86 | |
| North West (D3) | 0.9 x | 5.04 | 91.1 | 0.63 | 0.7 | 0.9 | 164.01 | |
| North West (D4) | 0.9 x | 5.04 | 91.1 | 0.63 | 0.7 | 0.9 | 164.01 | |
| | | | | | | **Total** | 984.13 | **(P3/P4)** |

## Internal gains:

| | **June** | **July** | **August** | |
|---|---|---|---|---|
| Internal gains | 625.07 | 600.98 | 610.7 | |
| Total summer gains | 1662.01 | 1585.12 | 1451.88 | **(P5)** |
| Summer gain/loss ratio | 3.5 | 3.34 | 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 | 18.35 | 20.19 | 19.71 | **(P7)** |
| **Likelihood of high internal temperature** | **Not significant** | **Not significant** | **Not significant** | |

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