# Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
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## Project Information:

**Assessed By:** Neil Ingham (STRO010943) **Building Type:** Semi-detached House

## Dwelling Details:

**NEW DWELLING DESIGN STAGE** Total Floor Area: 132.24m²

**Site Reference :** Hilltop Road - BASE **Plot Reference:** Hilltop Road

**Address :**

## Client Details:

**Name:**

**Address :**

**This report covers items included within the SAP calculations.**
**It is not a complete report of regulations compliance.**

## 1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

| | | |
|---|---|---|
| Target Carbon Dioxide Emission Rate (TER) | 17.98 kg/m² | |
| Dwelling Carbon Dioxide Emission Rate (DER) | 15.98 kg/m² | **OK** |

## 1b TFEE and DFEE

| | | |
|---|---|---|
| Target Fabric Energy Efficiency (TFEE) | 65.4 kWh/m² | |
| Dwelling Fabric Energy Efficiency (DFEE) | 58.3 kWh/m² | |
| | | **OK** |

## 2 Fabric U-values

| Element | Average | Highest | |
|---|---|---|---|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | **OK** |
| Party wall | 0.00 (max. 0.20) | - | **OK** |
| Floor | 0.15 (max. 0.25) | 0.15 (max. 0.70) | **OK** |
| Roof | 0.12 (max. 0.20) | 0.12 (max. 0.35) | **OK** |
| Openings | 1.40 (max. 2.00) | 1.40 (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: | Boiler systems with radiators or underfloor heating - mains gas<br>Data from manufacturer<br>Combi boiler<br>Efficiency 89.5 % SEDBUK2009<br>Minimum 88.0 % | **OK** |
| Secondary heating system: | None | |

## 5 Cylinder insulation

| | | |
|---|---|---|
| Hot water Storage: | No cylinder | |
| | | **N/A** |

# Regulations Compliance Report

## 6 Controls

| | | | |
|---|---|---|---|
| Space heating controls | TTZC by plumbing and electrical services | | **OK** |
| Hot water controls: | No cylinder thermostat | | |
| | No cylinder | | |
| Boiler interlock: | Yes | | **OK** |

## 7 Low energy lights

| | | |
|---|---|---|
| Percentage of fixed lights with low-energy fittings | 100.0% | |
| Minimum | 75.0% | **OK** |

## 8 Mechanical ventilation

Not applicable

## 9 Summertime temperature

| | | |
|---|---|---|
| Overheating risk (Thames valley): | Medium | **OK** |
| Based on: | | |
| Overshading: | Average or unknown | |
| Windows facing: East | 18.74m² | |
| Windows facing: West | 13.99m² | |
| Windows facing: North | 0.26m² | |
| Windows facing: South | 5.43m² | |
| Roof windows facing: Horizontal | 6.31m² | |
| Ventilation rate: | 4.00 | |

## 10 Key features

| | |
|---|---|
| Roofs U-value | 0.12 W/m²K |
| Party Walls U-value | 0 W/m²K |

# TER WorkSheet: New dwelling design stage

User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Neil Ingham | **Stroma Number:** | STRO010943 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.5.41 |

Property Address: Hilltop Road

**Address :**

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 54.76 | (1a) | x | 2.4 | (2a) | = | 131.42 | (3a) |
| First floor | 49.73 | (1b) | x | 2.9 | (2b) | = | 144.22 | (3b) |
| Second floor | 27.75 | (1c) | x | 2.7 | (2c) | = | 74.93 | (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 132.24 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 350.57 | (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 |

# TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.46 | 0.46 | 0.45 | 0.4 | 0.39 | 0.35 | 0.35 | 0.34 | 0.36 | 0.39 | 0.41 | 0.43 |

*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 | 0.58 | 0.56 | 0.56 | 0.56 | 0.57 | 0.58 | 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 | 0.58 | 0.56 | 0.56 | 0.56 | 0.57 | 0.58 | 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 | | | 2.19 | x | 1.2 | = | 2.628 | | | (26) |
| Windows Type 1 | | | 12.93 | x1/[1/( 1.4 )+ 0.04] | | = | 17.14 | | | (27) |
| Windows Type 2 | | | 9.66 | x1/[1/( 1.4 )+ 0.04] | | = | 12.81 | | | (27) |
| Windows Type 3 | | | 0.18 | x1/[1/( 1.4 )+ 0.04] | | = | 0.24 | | | (27) |
| Windows Type 4 | | | 3.75 | x1/[1/( 1.4 )+ 0.04] | | = | 4.97 | | | (27) |
| Rooflights | | | 4.354788 | x1/[1/(1.7) + 0.04] | | = | 7.403141 | | | (27b) |
| Floor | | | 54.76 | x | 0.13 | = | 7.1188 | | | (28) |
| Walls | 238.59 | 28.71 | 209.88 | x | 0.18 | = | 37.78 | | | (29) |
| Roof | 54.76 | 4.35 | 50.41 | x | 0.13 | = | 6.55 | | | (30) |
| Total area of elements, m² | | | 348.11 | | | | | | | (31) |
| Party wall | | | 7.06 | x | 0 | = | 0 | | | (32) |

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 96.17 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 19387.75 (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.*

# TER WorkSheet: New dwelling design stage

Thermal bridges : S (L x Y) calculated using Appendix K | 21.58 | (36)

*if details of thermal bridging are not known (36) = 0.05 x (31)*

Total fabric heat loss (33) + (36) = | 117.75 | (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= | 70.31 | 69.83 | 69.35 | 67.12 | 66.71 | 64.76 | 64.76 | 64.4 | 65.51 | 66.71 | 67.55 | 68.43 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 188.06 | 187.58 | 187.1 | 184.87 | 184.46 | 182.52 | 182.52 | 182.16 | 183.26 | 184.46 | 185.3 | 186.18 | |

Average = $Sum(39)_{1...12}$ /12= | 184.87 | (39)

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

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

Average = $Sum(40)_{1...12}$ /12= | 1.4 | (40)

Number of days in month (Table 1a)

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

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

Assumed occupancy, N | 2.9 | (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 | 103.09 | (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= | 113.4 | 109.27 | 105.15 | 101.03 | 96.9 | 92.78 | 92.78 | 96.9 | 101.03 | 105.15 | 109.27 | 113.4 |

Total = $Sum(44)_{1...12}$ = | 1237.06 | (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= | 168.17 | 147.08 | 151.77 | 132.32 | 126.96 | 109.56 | 101.52 | 116.5 | 117.89 | 137.39 | 149.97 | 162.86 |

Total = $Sum(45)_{1...12}$ = | 1621.98 | (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25.22 | 22.06 | 22.77 | 19.85 | 19.04 | 16.43 | 15.23 | 17.47 | 17.68 | 20.61 | 22.5 | 24.43 | (46) |

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

# TER WorkSheet: New dwelling design stage

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

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

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

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

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

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

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

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.96 | 49.32 | 49.38 | 45.75 | 47.28 | 49.38 | 49.32 | 50.96 | 49.32 | 50.96 | (61) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 219.12 | 193.11 | 202.73 | 181.63 | 176.34 | 155.31 | 148.8 | 165.88 | 167.2 | 188.35 | 199.29 | 213.82 | (62) |

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |
| FHRS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) (G2) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 219.12 | 193.11 | 202.73 | 181.63 | 176.34 | 155.31 | 148.8 | 165.88 | 167.2 | 188.35 | 199.29 | 213.82 | |

Output from water heater (annual)$_{1...12}$ 2211.59 (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= | 68.65 | 60.41 | 63.2 | 56.32 | 54.56 | 47.87 | 45.58 | 51.08 | 51.53 | 58.42 | 62.19 | 66.89 | (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= | 145.03 | 145.03 | 145.03 | 145.03 | 145.03 | 145.03 | 145.03 | 145.03 | 145.03 | 145.03 | 145.03 | 145.03 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 26.78 | 23.79 | 19.34 | 14.65 | 10.95 | 9.24 | 9.99 | 12.98 | 17.42 | 22.12 | 25.82 | 27.53 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 300.4 | 303.52 | 295.66 | 278.94 | 257.83 | 237.99 | 224.74 | 221.62 | 229.47 | 246.2 | 267.31 | 287.15 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.5 | 37.5 | 37.5 | 37.5 | 37.5 | 37.5 | 37.5 | 37.5 | 37.5 | 37.5 | 37.5 | 37.5 | (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= | -116.02 | -116.02 | -116.02 | -116.02 | -116.02 | -116.02 | -116.02 | -116.02 | -116.02 | -116.02 | -116.02 | -116.02 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 92.28 | 89.9 | 84.95 | 78.23 | 73.33 | 66.48 | 61.26 | 68.66 | 71.57 | 78.52 | 86.38 | 89.91 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 488.97 | 486.71 | 469.47 | 441.32 | 411.62 | 383.22 | 365.49 | 372.76 | 387.97 | 416.35 | 449.02 | 474.09 | (73) |

# TER WorkSheet: New dwelling design stage

## 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) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 0.9x | 0.77 | x | 0.18 | x | 10.63 | x | 0.63 | x | 0.7 | = | 0.58 | (74) |
| North | 0.9x | 0.77 | x | 0.18 | x | 20.32 | x | 0.63 | x | 0.7 | = | 1.12 | (74) |
| North | 0.9x | 0.77 | x | 0.18 | x | 34.53 | x | 0.63 | x | 0.7 | = | 1.9 | (74) |
| North | 0.9x | 0.77 | x | 0.18 | x | 55.46 | x | 0.63 | x | 0.7 | = | 3.05 | (74) |
| North | 0.9x | 0.77 | x | 0.18 | x | 74.72 | x | 0.63 | x | 0.7 | = | 4.11 | (74) |
| North | 0.9x | 0.77 | x | 0.18 | x | 79.99 | x | 0.63 | x | 0.7 | = | 4.4 | (74) |
| North | 0.9x | 0.77 | x | 0.18 | x | 74.68 | x | 0.63 | x | 0.7 | = | 4.11 | (74) |
| North | 0.9x | 0.77 | x | 0.18 | x | 59.25 | x | 0.63 | x | 0.7 | = | 3.26 | (74) |
| North | 0.9x | 0.77 | x | 0.18 | x | 41.52 | x | 0.63 | x | 0.7 | = | 2.28 | (74) |
| North | 0.9x | 0.77 | x | 0.18 | x | 24.19 | x | 0.63 | x | 0.7 | = | 1.33 | (74) |
| North | 0.9x | 0.77 | x | 0.18 | x | 13.12 | x | 0.63 | x | 0.7 | = | 0.72 | (74) |
| North | 0.9x | 0.77 | x | 0.18 | x | 8.86 | x | 0.63 | x | 0.7 | = | 0.49 | (74) |
| East | 0.9x | 0.77 | x | 12.93 | x | 19.64 | x | 0.63 | x | 0.7 | = | 77.61 | (76) |
| East | 0.9x | 0.77 | x | 12.93 | x | 38.42 | x | 0.63 | x | 0.7 | = | 151.82 | (76) |
| East | 0.9x | 0.77 | x | 12.93 | x | 63.27 | x | 0.63 | x | 0.7 | = | 250.03 | (76) |
| East | 0.9x | 0.77 | x | 12.93 | x | 92.28 | x | 0.63 | x | 0.7 | = | 364.65 | (76) |
| East | 0.9x | 0.77 | x | 12.93 | x | 113.09 | x | 0.63 | x | 0.7 | = | 446.89 | (76) |
| East | 0.9x | 0.77 | x | 12.93 | x | 115.77 | x | 0.63 | x | 0.7 | = | 457.48 | (76) |
| East | 0.9x | 0.77 | x | 12.93 | x | 110.22 | x | 0.63 | x | 0.7 | = | 435.54 | (76) |
| East | 0.9x | 0.77 | x | 12.93 | x | 94.68 | x | 0.63 | x | 0.7 | = | 374.12 | (76) |
| East | 0.9x | 0.77 | x | 12.93 | x | 73.59 | x | 0.63 | x | 0.7 | = | 290.79 | (76) |
| East | 0.9x | 0.77 | x | 12.93 | x | 45.59 | x | 0.63 | x | 0.7 | = | 180.15 | (76) |
| East | 0.9x | 0.77 | x | 12.93 | x | 24.49 | x | 0.63 | x | 0.7 | = | 96.77 | (76) |
| East | 0.9x | 0.77 | x | 12.93 | x | 16.15 | x | 0.63 | x | 0.7 | = | 63.82 | (76) |
| South | 0.9x | 0.77 | x | 3.75 | x | 46.75 | x | 0.63 | x | 0.7 | = | 53.58 | (78) |
| South | 0.9x | 0.77 | x | 3.75 | x | 76.57 | x | 0.63 | x | 0.7 | = | 87.75 | (78) |
| South | 0.9x | 0.77 | x | 3.75 | x | 97.53 | x | 0.63 | x | 0.7 | = | 111.78 | (78) |
| South | 0.9x | 0.77 | x | 3.75 | x | 110.23 | x | 0.63 | x | 0.7 | = | 126.33 | (78) |
| South | 0.9x | 0.77 | x | 3.75 | x | 114.87 | x | 0.63 | x | 0.7 | = | 131.65 | (78) |
| South | 0.9x | 0.77 | x | 3.75 | x | 110.55 | x | 0.63 | x | 0.7 | = | 126.69 | (78) |
| South | 0.9x | 0.77 | x | 3.75 | x | 108.01 | x | 0.63 | x | 0.7 | = | 123.79 | (78) |
| South | 0.9x | 0.77 | x | 3.75 | x | 104.89 | x | 0.63 | x | 0.7 | = | 120.21 | (78) |
| South | 0.9x | 0.77 | x | 3.75 | x | 101.89 | x | 0.63 | x | 0.7 | = | 116.77 | (78) |
| South | 0.9x | 0.77 | x | 3.75 | x | 82.59 | x | 0.63 | x | 0.7 | = | 94.65 | (78) |
| South | 0.9x | 0.77 | x | 3.75 | x | 55.42 | x | 0.63 | x | 0.7 | = | 63.51 | (78) |
| South | 0.9x | 0.77 | x | 3.75 | x | 40.4 | x | 0.63 | x | 0.7 | = | 46.3 | (78) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 9.66 | x | 19.64 | x | 0.63 | x | 0.7 | = | 57.98 | (80) |
| West | 0.9x | 0.77 | x | 9.66 | x | 38.42 | x | 0.63 | x | 0.7 | = | 113.43 | (80) |
| West | 0.9x | 0.77 | x | 9.66 | x | 63.27 | x | 0.63 | x | 0.7 | = | 186.8 | (80) |
| West | 0.9x | 0.77 | x | 9.66 | x | 92.28 | x | 0.63 | x | 0.7 | = | 272.43 | (80) |
| West | 0.9x | 0.77 | x | 9.66 | x | 113.09 | x | 0.63 | x | 0.7 | = | 333.87 | (80) |
| West | 0.9x | 0.77 | x | 9.66 | x | 115.77 | x | 0.63 | x | 0.7 | = | 341.78 | (80) |
| West | 0.9x | 0.77 | x | 9.66 | x | 110.22 | x | 0.63 | x | 0.7 | = | 325.39 | (80) |
| West | 0.9x | 0.77 | x | 9.66 | x | 94.68 | x | 0.63 | x | 0.7 | = | 279.5 | (80) |
| West | 0.9x | 0.77 | x | 9.66 | x | 73.59 | x | 0.63 | x | 0.7 | = | 217.25 | (80) |
| West | 0.9x | 0.77 | x | 9.66 | x | 45.59 | x | 0.63 | x | 0.7 | = | 134.59 | (80) |
| West | 0.9x | 0.77 | x | 9.66 | x | 24.49 | x | 0.63 | x | 0.7 | = | 72.3 | (80) |
| West | 0.9x | 0.77 | x | 9.66 | x | 16.15 | x | 0.63 | x | 0.7 | = | 47.68 | (80) |
| Rooflights | 0.9x | 1 | x | 4.35 | x | 26 | x | 0.63 | x | 0.7 | = | 44.94 | (82) |
| Rooflights | 0.9x | 1 | x | 4.35 | x | 54 | x | 0.63 | x | 0.7 | = | 93.33 | (82) |
| Rooflights | 0.9x | 1 | x | 4.35 | x | 96 | x | 0.63 | x | 0.7 | = | 165.93 | (82) |
| Rooflights | 0.9x | 1 | x | 4.35 | x | 150 | x | 0.63 | x | 0.7 | = | 259.26 | (82) |
| Rooflights | 0.9x | 1 | x | 4.35 | x | 192 | x | 0.63 | x | 0.7 | = | 331.86 | (82) |
| Rooflights | 0.9x | 1 | x | 4.35 | x | 200 | x | 0.63 | x | 0.7 | = | 345.68 | (82) |
| Rooflights | 0.9x | 1 | x | 4.35 | x | 189 | x | 0.63 | x | 0.7 | = | 326.67 | (82) |
| Rooflights | 0.9x | 1 | x | 4.35 | x | 157 | x | 0.63 | x | 0.7 | = | 271.36 | (82) |
| Rooflights | 0.9x | 1 | x | 4.35 | x | 115 | x | 0.63 | x | 0.7 | = | 198.77 | (82) |
| Rooflights | 0.9x | 1 | x | 4.35 | x | 66 | x | 0.63 | x | 0.7 | = | 114.08 | (82) |
| Rooflights | 0.9x | 1 | x | 4.35 | x | 33 | x | 0.63 | x | 0.7 | = | 57.04 | (82) |
| Rooflights | 0.9x | 1 | x | 4.35 | x | 21 | x | 0.63 | x | 0.7 | = | 36.3 | (82) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 234.7 | 447.45 | 716.43 | 1025.73 | 1248.38 | 1276.03 | 1215.49 | 1048.46 | 825.86 | 524.79 | 290.34 | 194.59 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 723.66 | 934.16 | 1185.9 | 1467.05 | 1660 | 1659.25 | 1580.98 | 1421.22 | 1213.83 | 941.14 | 739.35 | 668.67 | (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 | 0.98 | 0.94 | 0.83 | 0.65 | 0.49 | 0.56 | 0.83 | 0.98 | 1 | 1 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.36 | 19.58 | 19.95 | 20.41 | 20.76 | 20.94 | 20.99 | 20.98 | 20.82 | 20.32 | 19.75 | 19.33 | (87) |

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.91 | 0.77 | 0.55 | 0.36 | 0.43 | 0.75 | 0.96 | 1 | 1 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.58 | 17.91 | 18.44 | 19.1 | 19.55 | 19.74 | 19.77 | 19.77 | 19.64 | 18.99 | 18.16 | 17.54 | (90) |

fLA = Living area ÷ (4) = 0.1 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.76 | 18.07 | 18.59 | 19.23 | 19.67 | 19.86 | 19.89 | 19.89 | 19.75 | 19.12 | 18.31 | 17.72 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.76 | 18.07 | 18.59 | 19.23 | 19.67 | 19.86 | 19.89 | 19.89 | 19.75 | 19.12 | 18.31 | 17.72 | (93) |

## 8. Space heating requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.97 | 0.9 | 0.76 | 0.55 | 0.38 | 0.44 | 0.74 | 0.95 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 721.15 | 924.92 | 1148.9 | 1322.23 | 1260.86 | 920.28 | 595.21 | 624.78 | 902.45 | 896.96 | 733.76 | 667 | (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= | 2530.59 | 2470.47 | 2261.73 | 1909.44 | 1469.79 | 959.68 | 600.76 | 635.42 | 1036.21 | 1570.76 | 2078.14 | 2516.56 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 1346.22 | 1038.61 | 827.95 | 422.79 | 155.44 | 0 | 0 | 0 | 0 | 501.31 | 967.96 | 1376.07 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 6636.35 (98)

Space heating requirement in kWh/m²/year 50.18 (99)

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

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | |
| | 1346.22 | 1038.61 | 827.95 | 422.79 | 155.44 | 0 | 0 | 0 | 0 | 501.31 | 967.96 | 1376.07 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 1441.35 | 1112 | 886.45 | 452.66 | 166.43 | 0 | 0 | 0 | 0 | 536.73 | 1036.35 | 1473.31 | |

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 7105.3 (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)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 219.12 | 193.11 | 202.73 | 181.63 | 176.34 | 155.31 | 148.8 | 165.88 | 167.2 | 188.35 | 199.29 | 213.82 |

Efficiency of water heater 80.3 (216)

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 88.84 | 88.65 | 88.22 | 87.11 | 84.74 | 80.3 | 80.3 | 80.3 | 80.3 | 87.4 | 88.5 | 88.9 | (217) |

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 246.66 | 217.82 | 229.81 | 208.52 | 208.11 | 193.42 | 185.31 | 206.57 | 208.23 | 215.51 | 225.18 | 240.53 |

Total = Sum(219a)$_{1...12}$ = 2585.66 (219)

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 7105.3 | |
| Water heating fuel used | | | 2585.66 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 472.96 | (232) |
| Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = | | | 10238.92 | (338) |

## 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 | = | 1534.74 | (261) |
| Space heating (secondary) | (215) | x | 0.519 | = | 0 | (263) |
| Water heating | (219) | x | 0.216 | = | 558.5 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 2093.25 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) | x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) | x | 0.519 | = | 245.47 | (268) |
| Total CO2, kg/year | | | sum of (265)…(271) = | | 2377.64 | (272) |

**TER =** 17.98 (273)