Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.5
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Project Information:

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

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 91.5m²
Site Reference : Wardentree Lane **Plot Reference:** Plot 21
Address : Plot 21, 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)	18.14 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	14.49 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	54.9 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	53.0 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	**OK**
Party wall	0.00 (max. 0.20)	-	**OK**
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	**OK**
Roof	0.09 (max. 0.20)	0.09 (max. 0.35)	**OK**
Openings	1.39 (max. 2.00)	1.43 (max. 3.30)	**OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system: Database: (rev 404, product index 017688):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Vaillant
Model: ecoTEC pro 30 H combi A
Model qualifier: VUW GB 306/5-3 (Combi)
Efficiency 89.3 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

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

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (East Pennines):	Not significant	OK

Based on:

Overshading:	Average or unknown
Windows facing: North East	1.62m²
Windows facing: North East	1.62m²
Windows facing: North East	0.66m²
Windows facing: South East	3.38m²
Windows facing: South West	0.66m²
Windows facing: North West	1.26m²
Windows facing: North West	2.52m²
Windows facing: North East	1.44m²
Windows facing: North East	0.66m²
Windows facing: North East	1.44m²
Windows facing: South East	1.1m²
Windows facing: South East	1.1m²
Windows facing: North West	1.44m²
Ventilation rate:	4.00
Blinds/curtains:	
	Closed 100% of daylight hours

10 Key features

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

Thermal Bridge Report

Property Details: Plot 21

Address:	Plot 21, Land off Wardentree Lane, Spalding
Located in:	England
Region:	East Pennines

Thermal bridges:

Thermal bridges:

User-defined = UD
Default = D
Approved = A
User-defined (individual PSI-values) Y-Value = 0.0961

External Junctions Details:

Junction Type	PSI-Value	Length	Reference	Type
Steel lintel with perforated steel base plate	0.5	13.95	E1	[A]
Sill	0.04	11.74	E3	[A]
Jamb	0.05	32.1	E4	[A]
Ground floor (normal)	0.16	19.41	E5	[A]
Eaves (insulation at ceiling level)	0.06	8.1	E10	[A]
Gable (insulation at ceiling level)	0.24	11.37	E12	[A]
Corner (normal)	0.09	10	E16	[A]
Intermediate floor within a dwelling	0.07	19.41	E6	[A]
Party wall between dwellings	0.06	10	E18	[A]

Party Junctions Details:

Ground floor	0	8.1	P1	[UD]
Intermediate floor within a dwelling	0	8.1	P2	[UD]
Roof (insulation at ceiling level)	0	8.1	P4	[UD]

SAP Input

Property Details: Plot 21

Address:	Plot 21, Land off Wardentree Lane, Spalding
Located in:	England
Region:	East Pennines
UPRN:	
Date of assessment:	Thursday, January 5, 2017
Date of certificate:	Tuesday, January 10, 2017
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	404

Property description:

Dwelling type:	House
Detachment:	Detached
Year Completed:	2017

Floor Location:	Floor area:	Storey height:
Basement floor	45.75 m²	2.38 m
Floor 1	45.75 m²	2.62 m

Living area:	18.18 m² (fraction 0.199)
Front of dwelling faces:	North East

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Half glazed	low-E, En = 0.05, soft coat	Yes	PVC-U
Dining	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Living Room	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Living Bay 1	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Living Bay 2	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Living Bay 3	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Kitchen	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Dining	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Bedroom 2	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
En Suite	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Bedroom 1	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Bedroom 1 2	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Bath	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Bedroom 3	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Front Door	16mm or more mm	0.7	0.63	1	2.12	1
Dining	16mm or more	0.7	0.63	1.43	1.62	1
Living Room	16mm or more	0.7	0.63	1.43	1.62	1
Living Bay 1	16mm or more	0.7	0.63	1.43	0.66	1
Living Bay 2	16mm or more	0.7	0.63	1.43	3.38	1
Living Bay 3	16mm or more	0.7	0.63	1.43	0.66	1
Kitchen	16mm or more	0.7	0.63	1.43	1.26	1
Dining	16mm or more	0.7	0.63	1.43	2.52	1
Bedroom 2	16mm or more	0.7	0.63	1.43	1.44	1
En Suite	16mm or more	0.7	0.63	1.43	0.66	1
Bedroom 1	16mm or more	0.7	0.63	1.43	1.44	1
Bedroom 1 2	16mm or more	0.7	0.63	1.43	1.1	1

SAP Input

Bath	16mm or more	0.7	0.63	1.43	1.1	1
Bedroom 3	16mm or more	0.7	0.63	1.43	1.44	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front Door		External Wall	North East	1.01	2.1
Dining		External Wall	North East	1.2	1.35
Living Room		External Wall	North East	1.2	1.35
Living Bay 1		External Wall	North East	0.488	1.35
Living Bay 2		External Wall	South East	2.5	1.35
Living Bay 3		External Wall	South West	0.488	1.35
Kitchen		External Wall	North West	1.2	1.05
Dining		External Wall	North West	1.2	2.1
Bedroom 2		External Wall	North East	1.2	1.2
En Suite		External Wall	North East	0.63	1.05
Bedroom 1		External Wall	North East	1.2	1.2
Bedroom 1 2		External Wall	South East	0.915	1.2
Bath		External Wall	South East	0.915	1.2
Bedroom 3		External Wall	North West	1.2	1.2

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
External Wall	97.05	21.02	76.03	0.22	0	False	N/A
Main Roof	46.94	0	46.94	0.09	0		N/A
Ground Floor	45.75			0.12			N/A
Internal Elements							
Party Elements							
Party Walls	40.2						N/A

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0961

	Length	Psi-value		
[Approved]	13.95	0.5	E1	Steel lintel with perforated steel base plate
[Approved]	11.74	0.04	E3	Sill
[Approved]	32.1	0.05	E4	Jamb
[Approved]	19.41	0.16	E5	Ground floor (normal)
[Approved]	8.1	0.06	E10	Eaves (insulation at ceiling level)
[Approved]	11.37	0.24	E12	Gable (insulation at ceiling level)
[Approved]	10	0.09	E16	Corner (normal)
[Approved]	19.41	0.07	E6	Intermediate floor within a dwelling
[Approved]	10	0.06	E18	Party wall between dwellings
	8.1	0	P1	Ground floor
	8.1	0	P2	Intermediate floor within a dwelling
	8.1	0	P4	Roof (insulation at ceiling level)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	4
Number of passive stacks:	0
Number of sides sheltered:	0
Pressure test:	5

Main heating system:

SAP Input

Main heating system:	Boiler systems with radiators or underfloor heating Gas boilers and oil boilers Fuel: mains gas Info Source: Boiler Database Database: (rev 404, product index 017688) Efficiency: Winter 87.0 % Summer: 90.2 Brand name: Vaillant Model: ecoTEC pro 30 H combi A Model qualifier: VUW GB 306/5-3 (Combi boiler) Systems with radiators Central heating pump : 2013 or later Design flow temperature: Unknown Boiler interlock: Yes Delayed start
Main heating Control:	
Main heating Control:	Time and temperature zone control by suitable arrangement of plumbing and electrical services Control code: 2110
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Solar panel: False
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 Installed Peak power: 1 Tilt of collector: 45° Overshading: None or very little Collector Orientation: South West
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

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

Property Address: Plot 21

Address : Plot 21, Land off Wardentree Lane, Spalding

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	45.75 (1a)	x	2.38 (2a)	=	108.89	(3a)
Ground floor	45.75 (1b)	x	2.62 (2b)	=	119.86	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	91.5 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		228.75	(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) =	0.17	(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)			0.42	(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) =	0.42	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.54	0.53	0.52	0.47	0.46	0.4	0.4	0.39	0.42	0.46	0.48	0.5

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=	0.65	0.64	0.64	0.61	0.6	0.58	0.58	0.58	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=	0.65	0.64	0.64	0.61	0.6	0.58	0.58	0.58	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			2.12	x	1	=	2.12			(26)
Windows Type 1			1.62	x1/[1/(1.43)+ 0.04]		=	2.19			(27)
Windows Type 2			1.62	x1/[1/(1.43)+ 0.04]		=	2.19			(27)
Windows Type 3			0.66	x1/[1/(1.43)+ 0.04]		=	0.89			(27)
Windows Type 4			3.38	x1/[1/(1.43)+ 0.04]		=	4.57			(27)
Windows Type 5			0.66	x1/[1/(1.43)+ 0.04]		=	0.89			(27)
Windows Type 6			1.26	x1/[1/(1.43)+ 0.04]		=	1.7			(27)
Windows Type 7			2.52	x1/[1/(1.43)+ 0.04]		=	3.41			(27)
Windows Type 8			1.44	x1/[1/(1.43)+ 0.04]		=	1.95			(27)
Windows Type 9			0.66	x1/[1/(1.43)+ 0.04]		=	0.89			(27)
Windows Type 10			1.44	x1/[1/(1.43)+ 0.04]		=	1.95			(27)
Windows Type 11			1.1	x1/[1/(1.43)+ 0.04]		=	1.49			(27)
Windows Type 12			1.1	x1/[1/(1.43)+ 0.04]		=	1.49			(27)
Windows Type 13			1.44	x1/[1/(1.43)+ 0.04]		=	1.95			(27)
Floor			45.75	x	0.12	=	5.49			(28)
Walls	97.05	21.02	76.03	x	0.22	=	16.73			(29)
Roof	46.94	0	46.94	x	0.09	=	4.22			(30)

SAP WorkSheet: New dwelling design stage

Total area of elements, m²	189.74					(31)
Party wall	40.2	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) = 54.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10224.51 (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 18.23 (36)

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

Total fabric heat loss (33) + (36) = 72.35 (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=	48.82	48.39	47.97	45.99	45.62	43.89	43.89	43.57	44.56	45.62	46.37	47.15	(38)

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

(39)m=	121.17	120.74	120.32	118.34	117.97	116.25	116.25	115.93	116.91	117.97	118.72	119.5	

Average = Sum(39)$_{1...12}$ /12= 118.34 (39)

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

(40)m=	1.32	1.32	1.31	1.29	1.29	1.27	1.27	1.27	1.28	1.29	1.3	1.31	

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 2.65 (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 97.04 (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=	106.74	102.86	98.98	95.09	91.21	87.33	87.33	91.21	95.09	98.98	102.86	106.74	

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

Total = Sum(44)$_{1...12}$ = 1164.42 (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=	158.29	138.44	142.86	124.55	119.51	103.13	95.56	109.66	110.97	129.32	141.17	153.3	

Total = Sum(45)$_{1...12}$ = 1526.74 (45)

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

(46)m=	23.74	20.77	21.43	18.68	17.93	15.47	14.33	16.45	16.65	19.4	21.17	22.99	(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:

SAP WorkSheet: New dwelling design stage

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=	34.2	30.88	34.18	33.07	34.16	33.04	34.14	34.15	33.06	34.17	33.08	34.19	(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=	192.49	169.33	177.04	157.61	153.66	136.17	129.7	143.81	144.02	163.49	174.25	187.49	(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=	192.49	169.33	177.04	157.61	153.66	136.17	129.7	143.81	144.02	163.49	174.25	187.49	

Output from water heater (annual)$_{1...12}$ 1929.07 (64)

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

(65)m=	61.18	53.75	56.05	49.68	48.28	42.55	40.31	45	45.16	51.54	55.21	59.52	(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=	158.74	158.74	158.74	158.74	158.74	158.74	158.74	158.74	158.74	158.74	158.74	158.74	(66)

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

(67)m=	53.89	47.87	38.93	29.47	22.03	18.6	20.1	26.12	35.06	44.52	51.96	55.39	(67)

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

(68)m=	360.91	364.66	355.22	335.13	309.77	285.93	270	266.26	275.7	295.79	321.15	344.99	(68)

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

(69)m=	53.52	53.52	53.52	53.52	53.52	53.52	53.52	53.52	53.52	53.52	53.52	53.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

SAP WorkSheet: New dwelling design stage

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	(71)

Water heating gains (Table 5)

(72)m=	82.23	79.99	75.33	69	64.89	59.1	54.18	60.48	62.72	69.28	76.68	80	(72)

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

(73)m=	606.47	601.95	578.91	543.03	506.12	473.06	453.71	462.3	482.92	519.02	559.22	589.81	(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	1.62	x	11.28	x	0.63	x	0.7	=	5.59	(75)
Northeast 0.9x	0.77	x	1.62	x	11.28	x	0.63	x	0.7	=	5.59	(75)
Northeast 0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	1.62	x	22.97	x	0.63	x	0.7	=	11.37	(75)
Northeast 0.9x	0.77	x	1.62	x	22.97	x	0.63	x	0.7	=	11.37	(75)
Northeast 0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	1.62	x	41.38	x	0.63	x	0.7	=	20.49	(75)
Northeast 0.9x	0.77	x	1.62	x	41.38	x	0.63	x	0.7	=	20.49	(75)
Northeast 0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	1.62	x	67.96	x	0.63	x	0.7	=	33.64	(75)
Northeast 0.9x	0.77	x	1.62	x	67.96	x	0.63	x	0.7	=	33.64	(75)
Northeast 0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	1.62	x	91.35	x	0.63	x	0.7	=	45.22	(75)
Northeast 0.9x	0.77	x	1.62	x	91.35	x	0.63	x	0.7	=	45.22	(75)
Northeast 0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)
Northeast 0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)

SAP WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	1.62	x	97.38	x	0.63	x	0.7	=	48.21	(75)
Northeast	0.9x	0.77	x	1.62	x	97.38	x	0.63	x	0.7	=	48.21	(75)
Northeast	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(75)
Northeast	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(75)
Northeast	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast	0.9x	0.77	x	1.62	x	91.1	x	0.63	x	0.7	=	45.1	(75)
Northeast	0.9x	0.77	x	1.62	x	91.1	x	0.63	x	0.7	=	45.1	(75)
Northeast	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(75)
Northeast	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(75)
Northeast	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast	0.9x	0.77	x	1.62	x	72.63	x	0.63	x	0.7	=	35.96	(75)
Northeast	0.9x	0.77	x	1.62	x	72.63	x	0.63	x	0.7	=	35.96	(75)
Northeast	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(75)
Northeast	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(75)
Northeast	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast	0.9x	0.77	x	1.62	x	50.42	x	0.63	x	0.7	=	24.96	(75)
Northeast	0.9x	0.77	x	1.62	x	50.42	x	0.63	x	0.7	=	24.96	(75)
Northeast	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast	0.9x	0.77	x	1.62	x	28.07	x	0.63	x	0.7	=	13.9	(75)
Northeast	0.9x	0.77	x	1.62	x	28.07	x	0.63	x	0.7	=	13.9	(75)
Northeast	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	1.62	x	14.2	x	0.63	x	0.7	=	7.03	(75)
Northeast	0.9x	0.77	x	1.62	x	14.2	x	0.63	x	0.7	=	7.03	(75)
Northeast	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	1.62	x	9.21	x	0.63	x	0.7	=	4.56	(75)
Northeast	0.9x	0.77	x	1.62	x	9.21	x	0.63	x	0.7	=	4.56	(75)
Northeast	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(75)
Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Northeast	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(75)

SAP WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Southeast	0.9x	0.77	x	3.38	x	36.79	x	0.63	x	0.7	=	38.01	(77)
Southeast	0.9x	0.77	x	1.1	x	36.79	x	0.63	x	0.7	=	12.37	(77)
Southeast	0.9x	0.77	x	1.1	x	36.79	x	0.63	x	0.7	=	12.37	(77)
Southeast	0.9x	0.77	x	3.38	x	62.67	x	0.63	x	0.7	=	64.74	(77)
Southeast	0.9x	0.77	x	1.1	x	62.67	x	0.63	x	0.7	=	21.07	(77)
Southeast	0.9x	0.77	x	1.1	x	62.67	x	0.63	x	0.7	=	21.07	(77)
Southeast	0.9x	0.77	x	3.38	x	85.75	x	0.63	x	0.7	=	88.58	(77)
Southeast	0.9x	0.77	x	1.1	x	85.75	x	0.63	x	0.7	=	28.83	(77)
Southeast	0.9x	0.77	x	1.1	x	85.75	x	0.63	x	0.7	=	28.83	(77)
Southeast	0.9x	0.77	x	3.38	x	106.25	x	0.63	x	0.7	=	109.75	(77)
Southeast	0.9x	0.77	x	1.1	x	106.25	x	0.63	x	0.7	=	35.72	(77)
Southeast	0.9x	0.77	x	1.1	x	106.25	x	0.63	x	0.7	=	35.72	(77)
Southeast	0.9x	0.77	x	3.38	x	119.01	x	0.63	x	0.7	=	122.93	(77)
Southeast	0.9x	0.77	x	1.1	x	119.01	x	0.63	x	0.7	=	40.01	(77)
Southeast	0.9x	0.77	x	1.1	x	119.01	x	0.63	x	0.7	=	40.01	(77)
Southeast	0.9x	0.77	x	3.38	x	118.15	x	0.63	x	0.7	=	122.05	(77)
Southeast	0.9x	0.77	x	1.1	x	118.15	x	0.63	x	0.7	=	39.72	(77)
Southeast	0.9x	0.77	x	1.1	x	118.15	x	0.63	x	0.7	=	39.72	(77)
Southeast	0.9x	0.77	x	3.38	x	113.91	x	0.63	x	0.7	=	117.67	(77)
Southeast	0.9x	0.77	x	1.1	x	113.91	x	0.63	x	0.7	=	38.29	(77)
Southeast	0.9x	0.77	x	1.1	x	113.91	x	0.63	x	0.7	=	38.29	(77)
Southeast	0.9x	0.77	x	3.38	x	104.39	x	0.63	x	0.7	=	107.83	(77)
Southeast	0.9x	0.77	x	1.1	x	104.39	x	0.63	x	0.7	=	35.09	(77)
Southeast	0.9x	0.77	x	1.1	x	104.39	x	0.63	x	0.7	=	35.09	(77)
Southeast	0.9x	0.77	x	3.38	x	92.85	x	0.63	x	0.7	=	95.91	(77)
Southeast	0.9x	0.77	x	1.1	x	92.85	x	0.63	x	0.7	=	31.21	(77)
Southeast	0.9x	0.77	x	1.1	x	92.85	x	0.63	x	0.7	=	31.21	(77)
Southeast	0.9x	0.77	x	3.38	x	69.27	x	0.63	x	0.7	=	71.55	(77)
Southeast	0.9x	0.77	x	1.1	x	69.27	x	0.63	x	0.7	=	23.29	(77)
Southeast	0.9x	0.77	x	1.1	x	69.27	x	0.63	x	0.7	=	23.29	(77)
Southeast	0.9x	0.77	x	3.38	x	44.07	x	0.63	x	0.7	=	45.52	(77)
Southeast	0.9x	0.77	x	1.1	x	44.07	x	0.63	x	0.7	=	14.82	(77)
Southeast	0.9x	0.77	x	1.1	x	44.07	x	0.63	x	0.7	=	14.82	(77)
Southeast	0.9x	0.77	x	3.38	x	31.49	x	0.63	x	0.7	=	32.53	(77)
Southeast	0.9x	0.77	x	1.1	x	31.49	x	0.63	x	0.7	=	10.59	(77)
Southeast	0.9x	0.77	x	1.1	x	31.49	x	0.63	x	0.7	=	10.59	(77)
Southwest	0.9x	0.77	x	0.66	x	36.79		0.63	x	0.7	=	7.42	(79)
Southwest	0.9x	0.77	x	0.66	x	62.67		0.63	x	0.7	=	12.64	(79)
Southwest	0.9x	0.77	x	0.66	x	85.75		0.63	x	0.7	=	17.3	(79)
Southwest	0.9x	0.77	x	0.66	x	106.25		0.63	x	0.7	=	21.43	(79)

SAP WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	0.66	x	119.01		0.63	x	0.7	=	24	(79)
Southwest	0.9x	0.77	x	0.66	x	118.15		0.63	x	0.7	=	23.83	(79)
Southwest	0.9x	0.77	x	0.66	x	113.91		0.63	x	0.7	=	22.98	(79)
Southwest	0.9x	0.77	x	0.66	x	104.39		0.63	x	0.7	=	21.06	(79)
Southwest	0.9x	0.77	x	0.66	x	92.85		0.63	x	0.7	=	18.73	(79)
Southwest	0.9x	0.77	x	0.66	x	69.27		0.63	x	0.7	=	13.97	(79)
Southwest	0.9x	0.77	x	0.66	x	44.07		0.63	x	0.7	=	8.89	(79)
Southwest	0.9x	0.77	x	0.66	x	31.49		0.63	x	0.7	=	6.35	(79)
Northwest	0.9x	0.77	x	1.26	x	11.28	x	0.63	x	0.7	=	4.34	(81)
Northwest	0.9x	0.77	x	2.52	x	11.28	x	0.63	x	0.7	=	8.69	(81)
Northwest	0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(81)
Northwest	0.9x	0.77	x	1.26	x	22.97	x	0.63	x	0.7	=	8.84	(81)
Northwest	0.9x	0.77	x	2.52	x	22.97	x	0.63	x	0.7	=	17.69	(81)
Northwest	0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(81)
Northwest	0.9x	0.77	x	1.26	x	41.38	x	0.63	x	0.7	=	15.93	(81)
Northwest	0.9x	0.77	x	2.52	x	41.38	x	0.63	x	0.7	=	31.87	(81)
Northwest	0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(81)
Northwest	0.9x	0.77	x	1.26	x	67.96	x	0.63	x	0.7	=	26.17	(81)
Northwest	0.9x	0.77	x	2.52	x	67.96	x	0.63	x	0.7	=	52.34	(81)
Northwest	0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(81)
Northwest	0.9x	0.77	x	1.26	x	91.35	x	0.63	x	0.7	=	35.17	(81)
Northwest	0.9x	0.77	x	2.52	x	91.35	x	0.63	x	0.7	=	70.35	(81)
Northwest	0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(81)
Northwest	0.9x	0.77	x	1.26	x	97.38	x	0.63	x	0.7	=	37.5	(81)
Northwest	0.9x	0.77	x	2.52	x	97.38	x	0.63	x	0.7	=	75	(81)
Northwest	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(81)
Northwest	0.9x	0.77	x	1.26	x	91.1	x	0.63	x	0.7	=	35.08	(81)
Northwest	0.9x	0.77	x	2.52	x	91.1	x	0.63	x	0.7	=	70.16	(81)
Northwest	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(81)
Northwest	0.9x	0.77	x	1.26	x	72.63	x	0.63	x	0.7	=	27.97	(81)
Northwest	0.9x	0.77	x	2.52	x	72.63	x	0.63	x	0.7	=	55.93	(81)
Northwest	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(81)
Northwest	0.9x	0.77	x	1.26	x	50.42	x	0.63	x	0.7	=	19.42	(81)
Northwest	0.9x	0.77	x	2.52	x	50.42	x	0.63	x	0.7	=	38.83	(81)
Northwest	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(81)
Northwest	0.9x	0.77	x	1.26	x	28.07	x	0.63	x	0.7	=	10.81	(81)
Northwest	0.9x	0.77	x	2.52	x	28.07	x	0.63	x	0.7	=	21.62	(81)
Northwest	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(81)
Northwest	0.9x	0.77	x	1.26	x	14.2	x	0.63	x	0.7	=	5.47	(81)
Northwest	0.9x	0.77	x	2.52	x	14.2	x	0.63	x	0.7	=	10.93	(81)
Northwest	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(81)

SAP WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	1.26	x	9.21	x	0.63	x	0.7	=	3.55	(81)
Northwest 0.9x	0.77	x	2.52	x	9.21	x	0.63	x	0.7	=	7.1	(81)
Northwest 0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(81)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m=	113.82	208.38	323.63	465.55	580.38	602.1	569.7	480.07	372.15	240.69	138.97	95.7	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m=	720.29	810.33	902.54	1008.58	1086.5	1075.16	1023.42	942.37	855.07	759.71	698.19	685.51	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.93	0.83	0.65	0.49	0.55	0.8	0.95	0.99	1	(86)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(87)m=	19.7	19.86	20.14	20.51	20.8	20.95	20.99	20.98	20.87	20.5	20.04	19.68	(87)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(88)m=	19.82	19.83	19.83	19.85	19.85	19.86	19.86	19.87	19.86	19.85	19.84	19.84	(88)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(89)m=	0.99	0.98	0.97	0.91	0.77	0.55	0.37	0.42	0.71	0.93	0.98	0.99	(89)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(90)m=	18.12	18.36	18.76	19.29	19.66	19.83	19.86	19.86	19.76	19.29	18.63	18.1	(90)

fLA = Living area ÷ (4) = 0.2 (91)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(92)m=	18.44	18.66	19.03	19.53	19.89	20.06	20.08	20.08	19.98	19.53	18.91	18.41	(92)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(93)m=	18.29	18.51	18.88	19.38	19.74	19.91	19.93	19.93	19.83	19.38	18.76	18.26	(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:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	0.99	0.98	0.96	0.89	0.76	0.55	0.38	0.43	0.71	0.92	0.98	0.99	(94)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(95)m=	711.37	793.02	863.18	901.8	827.02	596.05	385	404.78	607.38	700.43	682.69	678.57	(95)

Monthly average external temperature from Table 8

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(97)m=	1694.67	1643.25	1490.14	1240.21	948.29	616.88	387.67	409.61	670.47	1035.73	1384.68	1680.64	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m=	731.58	571.36	466.46	243.65	90.22	0	0	0	0	249.46	505.44	745.54	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3603.71 (98)

Space heating requirement in kWh/m²/year 39.38 (99)

SAP WorkSheet: New dwelling design stage

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

Space heating:

Fraction of space heat from secondary/supplementary system		0 (201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1 (202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1 (204)
Efficiency of main space heating system 1		90.2 (206)
Efficiency of secondary/supplementary heating system, %		0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	731.58	571.36	466.46	243.65	90.22	0	0	0	0	249.46	505.44	745.54	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	811.06	633.43	517.14	270.13	100.03	0	0	0	0	276.57	560.35	826.54	

Total (kWh/year) =Sum(211)$_{1..5,10...12}$= 3995.25 (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)

	192.49	169.33	177.04	157.61	153.66	136.17	129.7	143.81	144.02	163.49	174.25	187.49	

Efficiency of water heater 87 (216)

(217)m=	89.51	89.45	89.3	88.92	88.16	87	87	87	87	88.91	89.36	89.54	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	215.04	189.3	198.26	177.26	174.31	156.52	149.08	165.3	165.54	183.9	195	209.4	

Total = Sum(219a)$_{1...12}$ = 2178.9 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3995.25
Water heating fuel used		2178.9
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		380.71 (232)
Electricity generated by PVs		-803.2 (233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)	**Fuel Cost** £/year
Space heating - main system 1	(211) x	3.48 x 0.01 =	139.03 (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)

SAP WorkSheet: New dwelling design stage

Water heating cost (other fuel)	(219)	3.48	x 0.01 =	75.83	(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 =	50.22	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-105.94	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			289.03	(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] =	0.89	(257)
SAP rating (Section 12)		87.59	(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	=	862.97	(261)
Space heating (secondary)	(215)	x		0.519	=	0	(263)
Water heating	(219)	x		0.216	=	470.64	(264)
Space and water heating	(261) + (262) + (263) + (264) =					1333.62	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x		0.519	=	38.93	(267)
Electricity for lighting	(232)	x		0.519	=	197.59	(268)
Energy saving/generation technologies Item 1				0.519	=	-416.86	(269)
Total CO2, kg/year			sum of (265)…(271) =			1153.27	(272)
CO2 emissions per m²			(272) ÷ (4) =			12.6	(273)
EI rating (section 14)						89	(274)

13a. Primary Energy

		Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x		1.22	=	4874.2	(261)
Space heating (secondary)	(215)	x		3.07	=	0	(263)
Energy for water heating	(219)	x		1.22	=	2658.26	(264)
Space and water heating	(261) + (262) + (263) + (264) =					7532.46	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x		3.07	=	230.25	(267)
Electricity for lighting	(232)	x		0	=	1168.79	(268)
Energy saving/generation technologies Item 1				3.07	=	-2465.81	(269)

SAP WorkSheet: New dwelling design stage

‘Total Primary Energy	sum of (265)…(271) =	6465.69	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =	70.66	(273)

Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

User Details:

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

Property Address: Plot 21

Address : Plot 21, Land off Wardentree Lane, Spalding

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	45.75	(1a) x	2.38	(2a) =	108.89	(3a)
Ground floor	45.75	(1b) x	2.62	(2b) =	119.86	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	91.5	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		228.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.13	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.38	(21)

Infiltration rate modified for monthly wind speed

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

Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.49	0.48	0.47	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.45

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0

(24a)

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

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0

(24b)

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0

(24c)

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

(24d)m=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6

(24d)

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

(25)m=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6

(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.12	x	1.2	=	2.544			(26)
Windows Type 1			1.62	x1/[1/(1.4)+ 0.04]		=	2.15			(27)
Windows Type 2			1.62	x1/[1/(1.4)+ 0.04]		=	2.15			(27)
Windows Type 3			0.66	x1/[1/(1.4)+ 0.04]		=	0.88			(27)
Windows Type 4			3.38	x1/[1/(1.4)+ 0.04]		=	4.48			(27)
Windows Type 5			0.66	x1/[1/(1.4)+ 0.04]		=	0.88			(27)
Windows Type 6			1.26	x1/[1/(1.4)+ 0.04]		=	1.67			(27)
Windows Type 7			2.52	x1/[1/(1.4)+ 0.04]		=	3.34			(27)
Windows Type 8			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 9			0.66	x1/[1/(1.4)+ 0.04]		=	0.88			(27)
Windows Type 10			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 11			1.1	x1/[1/(1.4)+ 0.04]		=	1.46			(27)
Windows Type 12			1.1	x1/[1/(1.4)+ 0.04]		=	1.46			(27)
Windows Type 13			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Floor			45.75	x	0.13	=	5.9475			(28)
Walls	97.05	21.02	76.03	x	0.18	=	13.69			(29)
Roof	46.94	0	46.94	x	0.13	=	6.1			(30)

Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

Total area of elements, m²	189.74					(31)
Party wall	40.2	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) = 53.34 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10224.51 (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 10.28 (36)

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

Total fabric heat loss (33) + (36) = 63.62 (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=	46.66	46.31	45.97	44.38	44.08	42.69	42.69	42.44	43.23	44.08	44.68	45.31	(38)

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

(39)m=	110.28	109.93	109.59	108	107.7	106.31	106.31	106.05	106.85	107.7	108.3	108.93	

Average = Sum(39)$_{1...12}$ /12= 108 (39)

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

(40)m=	1.21	1.2	1.2	1.18	1.18	1.16	1.16	1.16	1.17	1.18	1.18	1.19	

Average = Sum(40)$_{1...12}$ /12= 1.18 (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 2.65 (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 97.04 (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=	106.74	102.86	98.98	95.09	91.21	87.33	87.33	91.21	95.09	98.98	102.86	106.74	

Total = Sum(44)$_{1...12}$ = 1164.42 (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=	158.29	138.44	142.86	124.55	119.51	103.13	95.56	109.66	110.97	129.32	141.17	153.3	

Total = Sum(45)$_{1...12}$ = 1526.74 (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

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

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

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

Water storage loss:

Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

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=	134.55	117.68	121.43	105.87	101.58	87.66	81.23	93.21	94.32	109.92	119.99	130.3	(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=	134.55	117.68	121.43	105.87	101.58	87.66	81.23	93.21	94.32	109.92	119.99	130.3	

Output from water heater (annual)$_{1...12}$ | 1297.73 | (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=	33.64	29.42	30.36	26.47	25.4	21.91	20.31	23.3	23.58	27.48	30	32.58	(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=	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	(66)

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

(67)m=	21.56	19.15	15.57	11.79	8.81	7.44	8.04	10.45	14.02	17.81	20.78	22.16	(67)

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

(68)m=	241.81	244.32	238	224.54	207.54	191.57	180.9	178.39	184.72	198.18	215.17	231.14	(68)

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

(69)m=	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	(71)

Water heating gains (Table 5)

(72)m=	45.21	43.78	40.8	36.76	34.13	30.44	27.29	31.32	32.75	36.94	41.66	43.78	(72)

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

(73)m=	371.26	369.93	357.06	335.77	313.17	292.13	278.92	282.85	294.18	315.61	340.3	359.77	(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	1.62	x	11.28	x	0.63	x	0.7	=	5.59	(75)
Northeast 0.9x	0.77	x	1.62	x	11.28	x	0.63	x	0.7	=	5.59	(75)
Northeast 0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	1.62	x	22.97	x	0.63	x	0.7	=	11.37	(75)
Northeast 0.9x	0.77	x	1.62	x	22.97	x	0.63	x	0.7	=	11.37	(75)
Northeast 0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	1.62	x	41.38	x	0.63	x	0.7	=	20.49	(75)
Northeast 0.9x	0.77	x	1.62	x	41.38	x	0.63	x	0.7	=	20.49	(75)
Northeast 0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	1.62	x	67.96	x	0.63	x	0.7	=	33.64	(75)
Northeast 0.9x	0.77	x	1.62	x	67.96	x	0.63	x	0.7	=	33.64	(75)
Northeast 0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	1.62	x	91.35	x	0.63	x	0.7	=	45.22	(75)
Northeast 0.9x	0.77	x	1.62	x	91.35	x	0.63	x	0.7	=	45.22	(75)
Northeast 0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)
Northeast 0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)

Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	1.62	x	97.38	x	0.63	x	0.7	=	48.21	(75)
Northeast	0.9x	0.77	x	1.62	x	97.38	x	0.63	x	0.7	=	48.21	(75)
Northeast	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(75)
Northeast	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(75)
Northeast	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast	0.9x	0.77	x	1.62	x	91.1	x	0.63	x	0.7	=	45.1	(75)
Northeast	0.9x	0.77	x	1.62	x	91.1	x	0.63	x	0.7	=	45.1	(75)
Northeast	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(75)
Northeast	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(75)
Northeast	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast	0.9x	0.77	x	1.62	x	72.63	x	0.63	x	0.7	=	35.96	(75)
Northeast	0.9x	0.77	x	1.62	x	72.63	x	0.63	x	0.7	=	35.96	(75)
Northeast	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(75)
Northeast	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(75)
Northeast	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast	0.9x	0.77	x	1.62	x	50.42	x	0.63	x	0.7	=	24.96	(75)
Northeast	0.9x	0.77	x	1.62	x	50.42	x	0.63	x	0.7	=	24.96	(75)
Northeast	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast	0.9x	0.77	x	1.62	x	28.07	x	0.63	x	0.7	=	13.9	(75)
Northeast	0.9x	0.77	x	1.62	x	28.07	x	0.63	x	0.7	=	13.9	(75)
Northeast	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	1.62	x	14.2	x	0.63	x	0.7	=	7.03	(75)
Northeast	0.9x	0.77	x	1.62	x	14.2	x	0.63	x	0.7	=	7.03	(75)
Northeast	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	1.62	x	9.21	x	0.63	x	0.7	=	4.56	(75)
Northeast	0.9x	0.77	x	1.62	x	9.21	x	0.63	x	0.7	=	4.56	(75)
Northeast	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(75)
Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Northeast	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(75)

Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Southeast	0.9x	0.77	x	3.38	x	36.79	x	0.63	x	0.7	=	38.01	(77)
Southeast	0.9x	0.77	x	1.1	x	36.79	x	0.63	x	0.7	=	12.37	(77)
Southeast	0.9x	0.77	x	1.1	x	36.79	x	0.63	x	0.7	=	12.37	(77)
Southeast	0.9x	0.77	x	3.38	x	62.67	x	0.63	x	0.7	=	64.74	(77)
Southeast	0.9x	0.77	x	1.1	x	62.67	x	0.63	x	0.7	=	21.07	(77)
Southeast	0.9x	0.77	x	1.1	x	62.67	x	0.63	x	0.7	=	21.07	(77)
Southeast	0.9x	0.77	x	3.38	x	85.75	x	0.63	x	0.7	=	88.58	(77)
Southeast	0.9x	0.77	x	1.1	x	85.75	x	0.63	x	0.7	=	28.83	(77)
Southeast	0.9x	0.77	x	1.1	x	85.75	x	0.63	x	0.7	=	28.83	(77)
Southeast	0.9x	0.77	x	3.38	x	106.25	x	0.63	x	0.7	=	109.75	(77)
Southeast	0.9x	0.77	x	1.1	x	106.25	x	0.63	x	0.7	=	35.72	(77)
Southeast	0.9x	0.77	x	1.1	x	106.25	x	0.63	x	0.7	=	35.72	(77)
Southeast	0.9x	0.77	x	3.38	x	119.01	x	0.63	x	0.7	=	122.93	(77)
Southeast	0.9x	0.77	x	1.1	x	119.01	x	0.63	x	0.7	=	40.01	(77)
Southeast	0.9x	0.77	x	1.1	x	119.01	x	0.63	x	0.7	=	40.01	(77)
Southeast	0.9x	0.77	x	3.38	x	118.15	x	0.63	x	0.7	=	122.05	(77)
Southeast	0.9x	0.77	x	1.1	x	118.15	x	0.63	x	0.7	=	39.72	(77)
Southeast	0.9x	0.77	x	1.1	x	118.15	x	0.63	x	0.7	=	39.72	(77)
Southeast	0.9x	0.77	x	3.38	x	113.91	x	0.63	x	0.7	=	117.67	(77)
Southeast	0.9x	0.77	x	1.1	x	113.91	x	0.63	x	0.7	=	38.29	(77)
Southeast	0.9x	0.77	x	1.1	x	113.91	x	0.63	x	0.7	=	38.29	(77)
Southeast	0.9x	0.77	x	3.38	x	104.39	x	0.63	x	0.7	=	107.83	(77)
Southeast	0.9x	0.77	x	1.1	x	104.39	x	0.63	x	0.7	=	35.09	(77)
Southeast	0.9x	0.77	x	1.1	x	104.39	x	0.63	x	0.7	=	35.09	(77)
Southeast	0.9x	0.77	x	3.38	x	92.85	x	0.63	x	0.7	=	95.91	(77)
Southeast	0.9x	0.77	x	1.1	x	92.85	x	0.63	x	0.7	=	31.21	(77)
Southeast	0.9x	0.77	x	1.1	x	92.85	x	0.63	x	0.7	=	31.21	(77)
Southeast	0.9x	0.77	x	3.38	x	69.27	x	0.63	x	0.7	=	71.55	(77)
Southeast	0.9x	0.77	x	1.1	x	69.27	x	0.63	x	0.7	=	23.29	(77)
Southeast	0.9x	0.77	x	1.1	x	69.27	x	0.63	x	0.7	=	23.29	(77)
Southeast	0.9x	0.77	x	3.38	x	44.07	x	0.63	x	0.7	=	45.52	(77)
Southeast	0.9x	0.77	x	1.1	x	44.07	x	0.63	x	0.7	=	14.82	(77)
Southeast	0.9x	0.77	x	1.1	x	44.07	x	0.63	x	0.7	=	14.82	(77)
Southeast	0.9x	0.77	x	3.38	x	31.49	x	0.63	x	0.7	=	32.53	(77)
Southeast	0.9x	0.77	x	1.1	x	31.49	x	0.63	x	0.7	=	10.59	(77)
Southeast	0.9x	0.77	x	1.1	x	31.49	x	0.63	x	0.7	=	10.59	(77)
Southwest	0.9x	0.77	x	0.66	x	36.79		0.63	x	0.7	=	7.42	(79)
Southwest	0.9x	0.77	x	0.66	x	62.67		0.63	x	0.7	=	12.64	(79)
Southwest	0.9x	0.77	x	0.66	x	85.75		0.63	x	0.7	=	17.3	(79)
Southwest	0.9x	0.77	x	0.66	x	106.25		0.63	x	0.7	=	21.43	(79)

Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	0.66	x	119.01		0.63	x	0.7	=	24	(79)
Southwest	0.9x	0.77	x	0.66	x	118.15		0.63	x	0.7	=	23.83	(79)
Southwest	0.9x	0.77	x	0.66	x	113.91		0.63	x	0.7	=	22.98	(79)
Southwest	0.9x	0.77	x	0.66	x	104.39		0.63	x	0.7	=	21.06	(79)
Southwest	0.9x	0.77	x	0.66	x	92.85		0.63	x	0.7	=	18.73	(79)
Southwest	0.9x	0.77	x	0.66	x	69.27		0.63	x	0.7	=	13.97	(79)
Southwest	0.9x	0.77	x	0.66	x	44.07		0.63	x	0.7	=	8.89	(79)
Southwest	0.9x	0.77	x	0.66	x	31.49		0.63	x	0.7	=	6.35	(79)
Northwest	0.9x	0.77	x	1.26	x	11.28	x	0.63	x	0.7	=	4.34	(81)
Northwest	0.9x	0.77	x	2.52	x	11.28	x	0.63	x	0.7	=	8.69	(81)
Northwest	0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(81)
Northwest	0.9x	0.77	x	1.26	x	22.97	x	0.63	x	0.7	=	8.84	(81)
Northwest	0.9x	0.77	x	2.52	x	22.97	x	0.63	x	0.7	=	17.69	(81)
Northwest	0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(81)
Northwest	0.9x	0.77	x	1.26	x	41.38	x	0.63	x	0.7	=	15.93	(81)
Northwest	0.9x	0.77	x	2.52	x	41.38	x	0.63	x	0.7	=	31.87	(81)
Northwest	0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(81)
Northwest	0.9x	0.77	x	1.26	x	67.96	x	0.63	x	0.7	=	26.17	(81)
Northwest	0.9x	0.77	x	2.52	x	67.96	x	0.63	x	0.7	=	52.34	(81)
Northwest	0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(81)
Northwest	0.9x	0.77	x	1.26	x	91.35	x	0.63	x	0.7	=	35.17	(81)
Northwest	0.9x	0.77	x	2.52	x	91.35	x	0.63	x	0.7	=	70.35	(81)
Northwest	0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(81)
Northwest	0.9x	0.77	x	1.26	x	97.38	x	0.63	x	0.7	=	37.5	(81)
Northwest	0.9x	0.77	x	2.52	x	97.38	x	0.63	x	0.7	=	75	(81)
Northwest	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(81)
Northwest	0.9x	0.77	x	1.26	x	91.1	x	0.63	x	0.7	=	35.08	(81)
Northwest	0.9x	0.77	x	2.52	x	91.1	x	0.63	x	0.7	=	70.16	(81)
Northwest	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(81)
Northwest	0.9x	0.77	x	1.26	x	72.63	x	0.63	x	0.7	=	27.97	(81)
Northwest	0.9x	0.77	x	2.52	x	72.63	x	0.63	x	0.7	=	55.93	(81)
Northwest	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(81)
Northwest	0.9x	0.77	x	1.26	x	50.42	x	0.63	x	0.7	=	19.42	(81)
Northwest	0.9x	0.77	x	2.52	x	50.42	x	0.63	x	0.7	=	38.83	(81)
Northwest	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(81)
Northwest	0.9x	0.77	x	1.26	x	28.07	x	0.63	x	0.7	=	10.81	(81)
Northwest	0.9x	0.77	x	2.52	x	28.07	x	0.63	x	0.7	=	21.62	(81)
Northwest	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(81)
Northwest	0.9x	0.77	x	1.26	x	14.2	x	0.63	x	0.7	=	5.47	(81)
Northwest	0.9x	0.77	x	2.52	x	14.2	x	0.63	x	0.7	=	10.93	(81)
Northwest	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(81)

Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	1.26	x	9.21	x	0.63	x	0.7	=	3.55	(81)
Northwest 0.9x	0.77	x	2.52	x	9.21	x	0.63	x	0.7	=	7.1	(81)
Northwest 0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(81)

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

(83)m=	113.82	208.38	323.63	465.55	580.38	602.1	569.7	480.07	372.15	240.69	138.97	95.7	(83)

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

(84)m=	485.09	578.31	680.69	801.32	893.55	894.24	848.62	762.92	666.33	556.3	479.28	455.47	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.88	0.7	0.54	0.61	0.87	0.98	1	1	(86)

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

(87)m=	19.62	19.79	20.07	20.45	20.78	20.95	20.99	20.98	20.84	20.41	19.95	19.6	(87)

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

(88)m=	19.92	19.92	19.92	19.94	19.94	19.95	19.95	19.95	19.95	19.94	19.93	19.93	(88)

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

(89)m=	1	1	0.99	0.95	0.83	0.61	0.42	0.49	0.8	0.98	1	1	(89)

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

(90)m=	18.66	18.83	19.11	19.5	19.79	19.93	19.95	19.95	19.86	19.47	19	18.65	(90)

fLA = Living area ÷ (4) = 0.2 (91)

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

(92)m=	18.85	19.02	19.3	19.69	19.98	20.13	20.15	20.15	20.05	19.65	19.19	18.83	(92)

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

(93)m=	18.85	19.02	19.3	19.69	19.98	20.13	20.15	20.15	20.05	19.65	19.19	18.83	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.94	0.83	0.63	0.44	0.51	0.81	0.97	1	1	(94)

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

(95)m=	484.05	575.29	670.14	756.8	742.4	560.76	374.15	390.4	541.23	540.75	477.09	454.75	(95)

Monthly average external temperature from Table 8

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

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

(97)m=	1604.46	1551.84	1402.73	1164.83	892.24	587.85	377.9	397.93	635.82	975.11	1309.5	1594.23	(97)

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

(98)m=	833.58	656.25	545.05	293.78	111.47	0	0	0	0	323.16	599.34	847.77	

Total per year (kWh/year) = Sum(98)$_{1..5,9..12}$ = 4210.4 (98)

Space heating requirement in kWh/m²/year 46.02 (99)

Target Fabric Energy Efficiency WorkSheet: New dwelling design stage

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	999.33	786.71	806.01	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.88	0.94	0.91	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	883.55	736.44	730.58	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1145.15	1089.72	991.26	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	188.35	262.84	193.94	0	0	0	0	

Total = Sum(104) = 645.13 (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) = 0 (106)

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

(107)m=	0	0	0	0	0	47.09	65.71	48.49	0	0	0	0	

Total = Sum(107) = 161.28 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.76 (108)

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

Fabric Energy Efficiency — (99) + (108) = 47.78 (109)

Target Fabric Energy Efficiency (TFEE) 54.94 (109)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

User Details:

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

Property Address: Plot 21

Address : Plot 21, Land off Wardentree Lane, Spalding

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	45.75 (1a)	x	2.38 (2a)	=	108.89	(3a)
Ground floor	45.75 (1b)	x	2.62 (2b)	=	119.86	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	91.5 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		228.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.13 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration		0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate		(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.38 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered			0 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1 (20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.38 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.49	0.48	0.47	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.45

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

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

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

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

(24d)m=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(24d)

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

(25)m=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.12	x	1	=	2.12			(26)
Windows Type 1			1.62	x1/[1/(1.43)+ 0.04]		=	2.19			(27)
Windows Type 2			1.62	x1/[1/(1.43)+ 0.04]		=	2.19			(27)
Windows Type 3			0.66	x1/[1/(1.43)+ 0.04]		=	0.89			(27)
Windows Type 4			3.38	x1/[1/(1.43)+ 0.04]		=	4.57			(27)
Windows Type 5			0.66	x1/[1/(1.43)+ 0.04]		=	0.89			(27)
Windows Type 6			1.26	x1/[1/(1.43)+ 0.04]		=	1.7			(27)
Windows Type 7			2.52	x1/[1/(1.43)+ 0.04]		=	3.41			(27)
Windows Type 8			1.44	x1/[1/(1.43)+ 0.04]		=	1.95			(27)
Windows Type 9			0.66	x1/[1/(1.43)+ 0.04]		=	0.89			(27)
Windows Type 10			1.44	x1/[1/(1.43)+ 0.04]		=	1.95			(27)
Windows Type 11			1.1	x1/[1/(1.43)+ 0.04]		=	1.49			(27)
Windows Type 12			1.1	x1/[1/(1.43)+ 0.04]		=	1.49			(27)
Windows Type 13			1.44	x1/[1/(1.43)+ 0.04]		=	1.95			(27)
Floor			45.75	x	0.12	=	5.49			(28)
Walls	97.05	21.02	76.03	x	0.22	=	16.73			(29)
Roof	46.94	0	46.94	x	0.09	=	4.22			(30)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

Total area of elements, m²	189.74					(31)
Party wall	40.2	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) = 54.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10224.51 (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 18.23 (36)

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

Total fabric heat loss (33) + (36) = 72.35 (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=	46.66	46.31	45.97	44.38	44.08	42.69	42.69	42.44	43.23	44.08	44.68	45.31	(38)

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

(39)m=	119.01	118.67	118.33	116.73	116.43	115.05	115.05	114.79	115.58	116.43	117.04	117.67	

Average = Sum(39)$_{1...12}$ /12= 116.73 (39)

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

(40)m=	1.3	1.3	1.29	1.28	1.27	1.26	1.26	1.25	1.26	1.27	1.28	1.29	

Average = Sum(40)$_{1...12}$ /12= 1.28 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.65 (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 97.04 (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=	106.74	102.86	98.98	95.09	91.21	87.33	87.33	91.21	95.09	98.98	102.86	106.74	

Total = Sum(44)$_{1...12}$ = 1164.42 (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=	158.29	138.44	142.86	124.55	119.51	103.13	95.56	109.66	110.97	129.32	141.17	153.3	

Total = Sum(45)$_{1...12}$ = 1526.74 (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

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

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

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

Water storage loss:

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

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=	134.55	117.68	121.43	105.87	101.58	87.66	81.23	93.21	94.32	109.92	119.99	130.3	(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=	134.55	117.68	121.43	105.87	101.58	87.66	81.23	93.21	94.32	109.92	119.99	130.3	

Output from water heater (annual)$_{1...12}$ | 1297.73 | (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=	33.64	29.42	30.36	26.47	25.4	21.91	20.31	23.3	23.58	27.48	30	32.58	(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=	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	(66)

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

(67)m=	21.56	19.15	15.57	11.79	8.81	7.44	8.04	10.45	14.02	17.81	20.78	22.16	(67)

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

(68)m=	241.81	244.32	238	224.54	207.54	191.57	180.9	178.39	184.72	198.18	215.17	231.14	(68)

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

(69)m=	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	(71)

Water heating gains (Table 5)

(72)m=	45.21	43.78	40.8	36.76	34.13	30.44	27.29	31.32	32.75	36.94	41.66	43.78	(72)

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

(73)m=	371.26	369.93	357.06	335.77	313.17	292.13	278.92	282.85	294.18	315.61	340.3	359.77	(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	1.62	x	11.28	x	0.63	x	0.7	=	5.59	(75)
Northeast 0.9x	0.77	x	1.62	x	11.28	x	0.63	x	0.7	=	5.59	(75)
Northeast 0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	1.62	x	22.97	x	0.63	x	0.7	=	11.37	(75)
Northeast 0.9x	0.77	x	1.62	x	22.97	x	0.63	x	0.7	=	11.37	(75)
Northeast 0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	1.62	x	41.38	x	0.63	x	0.7	=	20.49	(75)
Northeast 0.9x	0.77	x	1.62	x	41.38	x	0.63	x	0.7	=	20.49	(75)
Northeast 0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	1.62	x	67.96	x	0.63	x	0.7	=	33.64	(75)
Northeast 0.9x	0.77	x	1.62	x	67.96	x	0.63	x	0.7	=	33.64	(75)
Northeast 0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	1.62	x	91.35	x	0.63	x	0.7	=	45.22	(75)
Northeast 0.9x	0.77	x	1.62	x	91.35	x	0.63	x	0.7	=	45.22	(75)
Northeast 0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)
Northeast 0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	1.62	x	97.38	x	0.63	x	0.7	=	48.21	(75)
Northeast	0.9x	0.77	x	1.62	x	97.38	x	0.63	x	0.7	=	48.21	(75)
Northeast	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(75)
Northeast	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(75)
Northeast	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast	0.9x	0.77	x	1.62	x	91.1	x	0.63	x	0.7	=	45.1	(75)
Northeast	0.9x	0.77	x	1.62	x	91.1	x	0.63	x	0.7	=	45.1	(75)
Northeast	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(75)
Northeast	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(75)
Northeast	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast	0.9x	0.77	x	1.62	x	72.63	x	0.63	x	0.7	=	35.96	(75)
Northeast	0.9x	0.77	x	1.62	x	72.63	x	0.63	x	0.7	=	35.96	(75)
Northeast	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(75)
Northeast	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(75)
Northeast	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast	0.9x	0.77	x	1.62	x	50.42	x	0.63	x	0.7	=	24.96	(75)
Northeast	0.9x	0.77	x	1.62	x	50.42	x	0.63	x	0.7	=	24.96	(75)
Northeast	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast	0.9x	0.77	x	1.62	x	28.07	x	0.63	x	0.7	=	13.9	(75)
Northeast	0.9x	0.77	x	1.62	x	28.07	x	0.63	x	0.7	=	13.9	(75)
Northeast	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	1.62	x	14.2	x	0.63	x	0.7	=	7.03	(75)
Northeast	0.9x	0.77	x	1.62	x	14.2	x	0.63	x	0.7	=	7.03	(75)
Northeast	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	1.62	x	9.21	x	0.63	x	0.7	=	4.56	(75)
Northeast	0.9x	0.77	x	1.62	x	9.21	x	0.63	x	0.7	=	4.56	(75)
Northeast	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(75)
Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Northeast	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(75)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Southeast	0.9x	0.77	x	3.38	x	36.79	x	0.63	x	0.7	=	38.01	(77)
Southeast	0.9x	0.77	x	1.1	x	36.79	x	0.63	x	0.7	=	12.37	(77)
Southeast	0.9x	0.77	x	1.1	x	36.79	x	0.63	x	0.7	=	12.37	(77)
Southeast	0.9x	0.77	x	3.38	x	62.67	x	0.63	x	0.7	=	64.74	(77)
Southeast	0.9x	0.77	x	1.1	x	62.67	x	0.63	x	0.7	=	21.07	(77)
Southeast	0.9x	0.77	x	1.1	x	62.67	x	0.63	x	0.7	=	21.07	(77)
Southeast	0.9x	0.77	x	3.38	x	85.75	x	0.63	x	0.7	=	88.58	(77)
Southeast	0.9x	0.77	x	1.1	x	85.75	x	0.63	x	0.7	=	28.83	(77)
Southeast	0.9x	0.77	x	1.1	x	85.75	x	0.63	x	0.7	=	28.83	(77)
Southeast	0.9x	0.77	x	3.38	x	106.25	x	0.63	x	0.7	=	109.75	(77)
Southeast	0.9x	0.77	x	1.1	x	106.25	x	0.63	x	0.7	=	35.72	(77)
Southeast	0.9x	0.77	x	1.1	x	106.25	x	0.63	x	0.7	=	35.72	(77)
Southeast	0.9x	0.77	x	3.38	x	119.01	x	0.63	x	0.7	=	122.93	(77)
Southeast	0.9x	0.77	x	1.1	x	119.01	x	0.63	x	0.7	=	40.01	(77)
Southeast	0.9x	0.77	x	1.1	x	119.01	x	0.63	x	0.7	=	40.01	(77)
Southeast	0.9x	0.77	x	3.38	x	118.15	x	0.63	x	0.7	=	122.05	(77)
Southeast	0.9x	0.77	x	1.1	x	118.15	x	0.63	x	0.7	=	39.72	(77)
Southeast	0.9x	0.77	x	1.1	x	118.15	x	0.63	x	0.7	=	39.72	(77)
Southeast	0.9x	0.77	x	3.38	x	113.91	x	0.63	x	0.7	=	117.67	(77)
Southeast	0.9x	0.77	x	1.1	x	113.91	x	0.63	x	0.7	=	38.29	(77)
Southeast	0.9x	0.77	x	1.1	x	113.91	x	0.63	x	0.7	=	38.29	(77)
Southeast	0.9x	0.77	x	3.38	x	104.39	x	0.63	x	0.7	=	107.83	(77)
Southeast	0.9x	0.77	x	1.1	x	104.39	x	0.63	x	0.7	=	35.09	(77)
Southeast	0.9x	0.77	x	1.1	x	104.39	x	0.63	x	0.7	=	35.09	(77)
Southeast	0.9x	0.77	x	3.38	x	92.85	x	0.63	x	0.7	=	95.91	(77)
Southeast	0.9x	0.77	x	1.1	x	92.85	x	0.63	x	0.7	=	31.21	(77)
Southeast	0.9x	0.77	x	1.1	x	92.85	x	0.63	x	0.7	=	31.21	(77)
Southeast	0.9x	0.77	x	3.38	x	69.27	x	0.63	x	0.7	=	71.55	(77)
Southeast	0.9x	0.77	x	1.1	x	69.27	x	0.63	x	0.7	=	23.29	(77)
Southeast	0.9x	0.77	x	1.1	x	69.27	x	0.63	x	0.7	=	23.29	(77)
Southeast	0.9x	0.77	x	3.38	x	44.07	x	0.63	x	0.7	=	45.52	(77)
Southeast	0.9x	0.77	x	1.1	x	44.07	x	0.63	x	0.7	=	14.82	(77)
Southeast	0.9x	0.77	x	1.1	x	44.07	x	0.63	x	0.7	=	14.82	(77)
Southeast	0.9x	0.77	x	3.38	x	31.49	x	0.63	x	0.7	=	32.53	(77)
Southeast	0.9x	0.77	x	1.1	x	31.49	x	0.63	x	0.7	=	10.59	(77)
Southeast	0.9x	0.77	x	1.1	x	31.49	x	0.63	x	0.7	=	10.59	(77)
Southwest	0.9x	0.77	x	0.66	x	36.79		0.63	x	0.7	=	7.42	(79)
Southwest	0.9x	0.77	x	0.66	x	62.67		0.63	x	0.7	=	12.64	(79)
Southwest	0.9x	0.77	x	0.66	x	85.75		0.63	x	0.7	=	17.3	(79)
Southwest	0.9x	0.77	x	0.66	x	106.25		0.63	x	0.7	=	21.43	(79)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	0.66	x	119.01		0.63	x	0.7	=	24	(79)
Southwest	0.9x	0.77	x	0.66	x	118.15		0.63	x	0.7	=	23.83	(79)
Southwest	0.9x	0.77	x	0.66	x	113.91		0.63	x	0.7	=	22.98	(79)
Southwest	0.9x	0.77	x	0.66	x	104.39		0.63	x	0.7	=	21.06	(79)
Southwest	0.9x	0.77	x	0.66	x	92.85		0.63	x	0.7	=	18.73	(79)
Southwest	0.9x	0.77	x	0.66	x	69.27		0.63	x	0.7	=	13.97	(79)
Southwest	0.9x	0.77	x	0.66	x	44.07		0.63	x	0.7	=	8.89	(79)
Southwest	0.9x	0.77	x	0.66	x	31.49		0.63	x	0.7	=	6.35	(79)
Northwest	0.9x	0.77	x	1.26	x	11.28	x	0.63	x	0.7	=	4.34	(81)
Northwest	0.9x	0.77	x	2.52	x	11.28	x	0.63	x	0.7	=	8.69	(81)
Northwest	0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(81)
Northwest	0.9x	0.77	x	1.26	x	22.97	x	0.63	x	0.7	=	8.84	(81)
Northwest	0.9x	0.77	x	2.52	x	22.97	x	0.63	x	0.7	=	17.69	(81)
Northwest	0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(81)
Northwest	0.9x	0.77	x	1.26	x	41.38	x	0.63	x	0.7	=	15.93	(81)
Northwest	0.9x	0.77	x	2.52	x	41.38	x	0.63	x	0.7	=	31.87	(81)
Northwest	0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(81)
Northwest	0.9x	0.77	x	1.26	x	67.96	x	0.63	x	0.7	=	26.17	(81)
Northwest	0.9x	0.77	x	2.52	x	67.96	x	0.63	x	0.7	=	52.34	(81)
Northwest	0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(81)
Northwest	0.9x	0.77	x	1.26	x	91.35	x	0.63	x	0.7	=	35.17	(81)
Northwest	0.9x	0.77	x	2.52	x	91.35	x	0.63	x	0.7	=	70.35	(81)
Northwest	0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(81)
Northwest	0.9x	0.77	x	1.26	x	97.38	x	0.63	x	0.7	=	37.5	(81)
Northwest	0.9x	0.77	x	2.52	x	97.38	x	0.63	x	0.7	=	75	(81)
Northwest	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(81)
Northwest	0.9x	0.77	x	1.26	x	91.1	x	0.63	x	0.7	=	35.08	(81)
Northwest	0.9x	0.77	x	2.52	x	91.1	x	0.63	x	0.7	=	70.16	(81)
Northwest	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(81)
Northwest	0.9x	0.77	x	1.26	x	72.63	x	0.63	x	0.7	=	27.97	(81)
Northwest	0.9x	0.77	x	2.52	x	72.63	x	0.63	x	0.7	=	55.93	(81)
Northwest	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(81)
Northwest	0.9x	0.77	x	1.26	x	50.42	x	0.63	x	0.7	=	19.42	(81)
Northwest	0.9x	0.77	x	2.52	x	50.42	x	0.63	x	0.7	=	38.83	(81)
Northwest	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(81)
Northwest	0.9x	0.77	x	1.26	x	28.07	x	0.63	x	0.7	=	10.81	(81)
Northwest	0.9x	0.77	x	2.52	x	28.07	x	0.63	x	0.7	=	21.62	(81)
Northwest	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(81)
Northwest	0.9x	0.77	x	1.26	x	14.2	x	0.63	x	0.7	=	5.47	(81)
Northwest	0.9x	0.77	x	2.52	x	14.2	x	0.63	x	0.7	=	10.93	(81)
Northwest	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(81)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

Northwest	0.9x	0.77	x	1.26	x	9.21	x	0.63	x	0.7	=	3.55	(81)
Northwest	0.9x	0.77	x	2.52	x	9.21	x	0.63	x	0.7	=	7.1	(81)
Northwest	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(81)

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

(83)m=	113.82	208.38	323.63	465.55	580.38	602.1	569.7	480.07	372.15	240.69	138.97	95.7	(83)

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

(84)m=	485.09	578.31	680.69	801.32	893.55	894.24	848.62	762.92	666.33	556.3	479.28	455.47	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.89	0.74	0.57	0.65	0.89	0.99	1	1	(86)

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

(87)m=	19.5	19.67	19.96	20.36	20.71	20.92	20.98	20.97	20.79	20.33	19.85	19.48	(87)

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

(88)m=	19.84	19.84	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.85	(88)

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

(89)m=	1	1	0.99	0.95	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=	18.48	18.65	18.94	19.34	19.67	19.84	19.87	19.87	19.75	19.33	18.84	18.46	(90)

fLA = Living area ÷ (4) = 0.2 (91)

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

(92)m=	18.68	18.85	19.14	19.55	19.88	20.05	20.09	20.09	19.96	19.53	19.04	18.66	(92)

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

(93)m=	18.68	18.85	19.14	19.55	19.88	20.05	20.09	20.09	19.96	19.53	19.04	18.66	(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	0.85	0.66	0.47	0.54	0.83	0.97	1	1	(94)

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

(95)m=	483.98	575.22	670.49	760.52	757.41	586.3	395.1	410.79	553.07	541.62	477.02	454.69	(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=	1711.34	1655.28	1495.84	1242.65	951.93	627.42	401.56	423.08	677.11	1039.28	1397.36	1701.97	(97)

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

(98)m=	913.16	725.8	614.07	347.13	144.73	0	0	0	0	370.26	662.64	927.97	

Total per year (kWh/year) = Sum(98)$_{1..5,9..12}$ = 4705.75 (98)

Space heating requirement in kWh/m²/year 51.43 (99)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

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	1081.44	851.35	872.4	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	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	915.7	773.6	761.16	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1145.15	1089.72	991.26	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	165.21	235.19	171.19	0	0	0	0	

Total = Sum(104) = 571.6 (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) = 0 (106)

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

(107)m=	0	0	0	0	0	41.3	58.8	42.8	0	0	0	0	

Total = Sum(107) = 142.9 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.56 (108)

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

Fabric Energy Efficiency — (99) + (108) = 52.99 (109)

DER WorkSheet: New dwelling design stage

User Details:

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

Property Address: Plot 21

Address : Plot 21, Land off Wardentree Lane, Spalding

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	45.75	(1a) x	2.38	(2a) =	108.89	(3a)
Ground floor	45.75	(1b) x	2.62	(2b) =	119.86	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	91.5	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		228.75	(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) =	0.17	(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)			0.42	(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) =		0.42	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.54	0.53	0.52	0.47	0.46	0.4	0.4	0.39	0.42	0.46	0.48	0.5

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=	0.65	0.64	0.64	0.61	0.6	0.58	0.58	0.58	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=	0.65	0.64	0.64	0.61	0.6	0.58	0.58	0.58	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			2.12	x	1	=	2.12			(26)
Windows Type 1			1.62	x	1/[1/(1.43)+ 0.04]	=	2.19			(27)
Windows Type 2			1.62	x	1/[1/(1.43)+ 0.04]	=	2.19			(27)
Windows Type 3			0.66	x	1/[1/(1.43)+ 0.04]	=	0.89			(27)
Windows Type 4			3.38	x	1/[1/(1.43)+ 0.04]	=	4.57			(27)
Windows Type 5			0.66	x	1/[1/(1.43)+ 0.04]	=	0.89			(27)
Windows Type 6			1.26	x	1/[1/(1.43)+ 0.04]	=	1.7			(27)
Windows Type 7			2.52	x	1/[1/(1.43)+ 0.04]	=	3.41			(27)
Windows Type 8			1.44	x	1/[1/(1.43)+ 0.04]	=	1.95			(27)
Windows Type 9			0.66	x	1/[1/(1.43)+ 0.04]	=	0.89			(27)
Windows Type 10			1.44	x	1/[1/(1.43)+ 0.04]	=	1.95			(27)
Windows Type 11			1.1	x	1/[1/(1.43)+ 0.04]	=	1.49			(27)
Windows Type 12			1.1	x	1/[1/(1.43)+ 0.04]	=	1.49			(27)
Windows Type 13			1.44	x	1/[1/(1.43)+ 0.04]	=	1.95			(27)
Floor			45.75	x	0.12	=	5.49			(28)
Walls	97.05	21.02	76.03	x	0.22	=	16.73			(29)
Roof	46.94	0	46.94	x	0.09	=	4.22			(30)

DER WorkSheet: New dwelling design stage

Total area of elements, m²	189.74					(31)
Party wall	40.2	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) = 54.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10224.51 (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 18.23 (36)

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

Total fabric heat loss (33) + (36) = 72.35 (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=	48.82	48.39	47.97	45.99	45.62	43.89	43.89	43.57	44.56	45.62	46.37	47.15	(38)

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

(39)m=	121.17	120.74	120.32	118.34	117.97	116.25	116.25	115.93	116.91	117.97	118.72	119.5	

Average = Sum(39)$_{1...12}$ /12= 118.34 (39)

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

(40)m=	1.32	1.32	1.31	1.29	1.29	1.27	1.27	1.27	1.28	1.29	1.3	1.31	

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 2.65 (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 97.04 (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=	106.74	102.86	98.98	95.09	91.21	87.33	87.33	91.21	95.09	98.98	102.86	106.74	

Total = Sum(44)$_{1...12}$ = 1164.42 (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=	158.29	138.44	142.86	124.55	119.51	103.13	95.56	109.66	110.97	129.32	141.17	153.3	

Total = Sum(45)$_{1...12}$ = 1526.74 (45)

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

(46)m=	23.74	20.77	21.43	18.68	17.93	15.47	14.33	16.45	16.65	19.4	21.17	22.99	(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:

DER WorkSheet: New dwelling design stage

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=	34.2	30.88	34.18	33.07	34.16	33.04	34.14	34.15	33.06	34.17	33.08	34.19	(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=	192.49	169.33	177.04	157.61	153.66	136.17	129.7	143.81	144.02	163.49	174.25	187.49	(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=	192.49	169.33	177.04	157.61	153.66	136.17	129.7	143.81	144.02	163.49	174.25	187.49	

Output from water heater (annual)$_{1...12}$ | 1929.07 | (64)

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

(65)m=	61.18	53.75	56.05	49.68	48.28	42.55	40.31	45	45.16	51.54	55.21	59.52	(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=	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	(66)

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

(67)m=	21.56	19.15	15.57	11.79	8.81	7.44	8.04	10.45	14.02	17.81	20.78	22.16	(67)

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

(68)m=	241.81	244.32	238	224.54	207.54	191.57	180.9	178.39	184.72	198.18	215.17	231.14	(68)

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

(69)m=	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

DER WorkSheet: New dwelling design stage

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	(71)

Water heating gains (Table 5)

(72)m=	82.23	79.99	75.33	69	64.89	59.1	54.18	60.48	62.72	69.28	76.68	80	(72)

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

(73)m=	411.29	409.14	394.59	371.01	346.93	323.79	308.8	315.01	327.15	350.95	378.32	398.98	(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	1.62	x	11.28	x	0.63	x	0.7	=	5.59	(75)
Northeast 0.9x	0.77	x	1.62	x	11.28	x	0.63	x	0.7	=	5.59	(75)
Northeast 0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	1.62	x	22.97	x	0.63	x	0.7	=	11.37	(75)
Northeast 0.9x	0.77	x	1.62	x	22.97	x	0.63	x	0.7	=	11.37	(75)
Northeast 0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	1.62	x	41.38	x	0.63	x	0.7	=	20.49	(75)
Northeast 0.9x	0.77	x	1.62	x	41.38	x	0.63	x	0.7	=	20.49	(75)
Northeast 0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	1.62	x	67.96	x	0.63	x	0.7	=	33.64	(75)
Northeast 0.9x	0.77	x	1.62	x	67.96	x	0.63	x	0.7	=	33.64	(75)
Northeast 0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	1.62	x	91.35	x	0.63	x	0.7	=	45.22	(75)
Northeast 0.9x	0.77	x	1.62	x	91.35	x	0.63	x	0.7	=	45.22	(75)
Northeast 0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)
Northeast 0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)

DER WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	1.62	x	97.38	x	0.63	x	0.7	=	48.21	(75)
Northeast	0.9x	0.77	x	1.62	x	97.38	x	0.63	x	0.7	=	48.21	(75)
Northeast	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(75)
Northeast	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(75)
Northeast	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast	0.9x	0.77	x	1.62	x	91.1	x	0.63	x	0.7	=	45.1	(75)
Northeast	0.9x	0.77	x	1.62	x	91.1	x	0.63	x	0.7	=	45.1	(75)
Northeast	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(75)
Northeast	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(75)
Northeast	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast	0.9x	0.77	x	1.62	x	72.63	x	0.63	x	0.7	=	35.96	(75)
Northeast	0.9x	0.77	x	1.62	x	72.63	x	0.63	x	0.7	=	35.96	(75)
Northeast	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(75)
Northeast	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(75)
Northeast	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast	0.9x	0.77	x	1.62	x	50.42	x	0.63	x	0.7	=	24.96	(75)
Northeast	0.9x	0.77	x	1.62	x	50.42	x	0.63	x	0.7	=	24.96	(75)
Northeast	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast	0.9x	0.77	x	1.62	x	28.07	x	0.63	x	0.7	=	13.9	(75)
Northeast	0.9x	0.77	x	1.62	x	28.07	x	0.63	x	0.7	=	13.9	(75)
Northeast	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	1.62	x	14.2	x	0.63	x	0.7	=	7.03	(75)
Northeast	0.9x	0.77	x	1.62	x	14.2	x	0.63	x	0.7	=	7.03	(75)
Northeast	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	1.62	x	9.21	x	0.63	x	0.7	=	4.56	(75)
Northeast	0.9x	0.77	x	1.62	x	9.21	x	0.63	x	0.7	=	4.56	(75)
Northeast	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(75)
Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Northeast	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(75)

DER WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Southeast	0.9x	0.77	x	3.38	x	36.79	x	0.63	x	0.7	=	38.01	(77)
Southeast	0.9x	0.77	x	1.1	x	36.79	x	0.63	x	0.7	=	12.37	(77)
Southeast	0.9x	0.77	x	1.1	x	36.79	x	0.63	x	0.7	=	12.37	(77)
Southeast	0.9x	0.77	x	3.38	x	62.67	x	0.63	x	0.7	=	64.74	(77)
Southeast	0.9x	0.77	x	1.1	x	62.67	x	0.63	x	0.7	=	21.07	(77)
Southeast	0.9x	0.77	x	1.1	x	62.67	x	0.63	x	0.7	=	21.07	(77)
Southeast	0.9x	0.77	x	3.38	x	85.75	x	0.63	x	0.7	=	88.58	(77)
Southeast	0.9x	0.77	x	1.1	x	85.75	x	0.63	x	0.7	=	28.83	(77)
Southeast	0.9x	0.77	x	1.1	x	85.75	x	0.63	x	0.7	=	28.83	(77)
Southeast	0.9x	0.77	x	3.38	x	106.25	x	0.63	x	0.7	=	109.75	(77)
Southeast	0.9x	0.77	x	1.1	x	106.25	x	0.63	x	0.7	=	35.72	(77)
Southeast	0.9x	0.77	x	1.1	x	106.25	x	0.63	x	0.7	=	35.72	(77)
Southeast	0.9x	0.77	x	3.38	x	119.01	x	0.63	x	0.7	=	122.93	(77)
Southeast	0.9x	0.77	x	1.1	x	119.01	x	0.63	x	0.7	=	40.01	(77)
Southeast	0.9x	0.77	x	1.1	x	119.01	x	0.63	x	0.7	=	40.01	(77)
Southeast	0.9x	0.77	x	3.38	x	118.15	x	0.63	x	0.7	=	122.05	(77)
Southeast	0.9x	0.77	x	1.1	x	118.15	x	0.63	x	0.7	=	39.72	(77)
Southeast	0.9x	0.77	x	1.1	x	118.15	x	0.63	x	0.7	=	39.72	(77)
Southeast	0.9x	0.77	x	3.38	x	113.91	x	0.63	x	0.7	=	117.67	(77)
Southeast	0.9x	0.77	x	1.1	x	113.91	x	0.63	x	0.7	=	38.29	(77)
Southeast	0.9x	0.77	x	1.1	x	113.91	x	0.63	x	0.7	=	38.29	(77)
Southeast	0.9x	0.77	x	3.38	x	104.39	x	0.63	x	0.7	=	107.83	(77)
Southeast	0.9x	0.77	x	1.1	x	104.39	x	0.63	x	0.7	=	35.09	(77)
Southeast	0.9x	0.77	x	1.1	x	104.39	x	0.63	x	0.7	=	35.09	(77)
Southeast	0.9x	0.77	x	3.38	x	92.85	x	0.63	x	0.7	=	95.91	(77)
Southeast	0.9x	0.77	x	1.1	x	92.85	x	0.63	x	0.7	=	31.21	(77)
Southeast	0.9x	0.77	x	1.1	x	92.85	x	0.63	x	0.7	=	31.21	(77)
Southeast	0.9x	0.77	x	3.38	x	69.27	x	0.63	x	0.7	=	71.55	(77)
Southeast	0.9x	0.77	x	1.1	x	69.27	x	0.63	x	0.7	=	23.29	(77)
Southeast	0.9x	0.77	x	1.1	x	69.27	x	0.63	x	0.7	=	23.29	(77)
Southeast	0.9x	0.77	x	3.38	x	44.07	x	0.63	x	0.7	=	45.52	(77)
Southeast	0.9x	0.77	x	1.1	x	44.07	x	0.63	x	0.7	=	14.82	(77)
Southeast	0.9x	0.77	x	1.1	x	44.07	x	0.63	x	0.7	=	14.82	(77)
Southeast	0.9x	0.77	x	3.38	x	31.49	x	0.63	x	0.7	=	32.53	(77)
Southeast	0.9x	0.77	x	1.1	x	31.49	x	0.63	x	0.7	=	10.59	(77)
Southeast	0.9x	0.77	x	1.1	x	31.49	x	0.63	x	0.7	=	10.59	(77)
Southwest	0.9x	0.77	x	0.66	x	36.79		0.63	x	0.7	=	7.42	(79)
Southwest	0.9x	0.77	x	0.66	x	62.67		0.63	x	0.7	=	12.64	(79)
Southwest	0.9x	0.77	x	0.66	x	85.75		0.63	x	0.7	=	17.3	(79)
Southwest	0.9x	0.77	x	0.66	x	106.25		0.63	x	0.7	=	21.43	(79)

DER WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	0.66	x	119.01		0.63	x	0.7	=	24	(79)
Southwest	0.9x	0.77	x	0.66	x	118.15		0.63	x	0.7	=	23.83	(79)
Southwest	0.9x	0.77	x	0.66	x	113.91		0.63	x	0.7	=	22.98	(79)
Southwest	0.9x	0.77	x	0.66	x	104.39		0.63	x	0.7	=	21.06	(79)
Southwest	0.9x	0.77	x	0.66	x	92.85		0.63	x	0.7	=	18.73	(79)
Southwest	0.9x	0.77	x	0.66	x	69.27		0.63	x	0.7	=	13.97	(79)
Southwest	0.9x	0.77	x	0.66	x	44.07		0.63	x	0.7	=	8.89	(79)
Southwest	0.9x	0.77	x	0.66	x	31.49		0.63	x	0.7	=	6.35	(79)
Northwest	0.9x	0.77	x	1.26	x	11.28	x	0.63	x	0.7	=	4.34	(81)
Northwest	0.9x	0.77	x	2.52	x	11.28	x	0.63	x	0.7	=	8.69	(81)
Northwest	0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(81)
Northwest	0.9x	0.77	x	1.26	x	22.97	x	0.63	x	0.7	=	8.84	(81)
Northwest	0.9x	0.77	x	2.52	x	22.97	x	0.63	x	0.7	=	17.69	(81)
Northwest	0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(81)
Northwest	0.9x	0.77	x	1.26	x	41.38	x	0.63	x	0.7	=	15.93	(81)
Northwest	0.9x	0.77	x	2.52	x	41.38	x	0.63	x	0.7	=	31.87	(81)
Northwest	0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(81)
Northwest	0.9x	0.77	x	1.26	x	67.96	x	0.63	x	0.7	=	26.17	(81)
Northwest	0.9x	0.77	x	2.52	x	67.96	x	0.63	x	0.7	=	52.34	(81)
Northwest	0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(81)
Northwest	0.9x	0.77	x	1.26	x	91.35	x	0.63	x	0.7	=	35.17	(81)
Northwest	0.9x	0.77	x	2.52	x	91.35	x	0.63	x	0.7	=	70.35	(81)
Northwest	0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(81)
Northwest	0.9x	0.77	x	1.26	x	97.38	x	0.63	x	0.7	=	37.5	(81)
Northwest	0.9x	0.77	x	2.52	x	97.38	x	0.63	x	0.7	=	75	(81)
Northwest	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(81)
Northwest	0.9x	0.77	x	1.26	x	91.1	x	0.63	x	0.7	=	35.08	(81)
Northwest	0.9x	0.77	x	2.52	x	91.1	x	0.63	x	0.7	=	70.16	(81)
Northwest	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(81)
Northwest	0.9x	0.77	x	1.26	x	72.63	x	0.63	x	0.7	=	27.97	(81)
Northwest	0.9x	0.77	x	2.52	x	72.63	x	0.63	x	0.7	=	55.93	(81)
Northwest	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(81)
Northwest	0.9x	0.77	x	1.26	x	50.42	x	0.63	x	0.7	=	19.42	(81)
Northwest	0.9x	0.77	x	2.52	x	50.42	x	0.63	x	0.7	=	38.83	(81)
Northwest	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(81)
Northwest	0.9x	0.77	x	1.26	x	28.07	x	0.63	x	0.7	=	10.81	(81)
Northwest	0.9x	0.77	x	2.52	x	28.07	x	0.63	x	0.7	=	21.62	(81)
Northwest	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(81)
Northwest	0.9x	0.77	x	1.26	x	14.2	x	0.63	x	0.7	=	5.47	(81)
Northwest	0.9x	0.77	x	2.52	x	14.2	x	0.63	x	0.7	=	10.93	(81)
Northwest	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(81)

DER WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	1.26	x	9.21	x	0.63	x	0.7	=	3.55	(81)
Northwest 0.9x	0.77	x	2.52	x	9.21	x	0.63	x	0.7	=	7.1	(81)
Northwest 0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(81)

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

(83)m=	113.82	208.38	323.63	465.55	580.38	602.1	569.7	480.07	372.15	240.69	138.97	95.7	(83)

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

(84)m=	525.11	617.52	718.21	836.56	927.31	925.9	878.51	795.08	699.3	591.64	517.29	494.68	(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	0.96	0.88	0.72	0.56	0.63	0.88	0.98	1	1	(86)

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

(87)m=	19.51	19.68	19.97	20.37	20.72	20.93	20.98	20.97	20.8	20.35	19.87	19.49	(87)

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

(88)m=	19.82	19.83	19.83	19.85	19.85	19.86	19.86	19.87	19.86	19.85	19.84	19.84	(88)

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

(89)m=	1	0.99	0.99	0.95	0.84	0.62	0.43	0.49	0.81	0.97	1	1	(89)

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

(90)m=	17.84	18.09	18.52	19.11	19.58	19.81	19.86	19.85	19.7	19.09	18.38	17.83	(90)

fLA = Living area ÷ (4) = 0.2 (91)

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

(92)m=	18.18	18.41	18.81	19.36	19.8	20.04	20.08	20.08	19.92	19.34	18.68	18.16	(92)

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

(93)m=	18.03	18.26	18.66	19.21	19.65	19.89	19.93	19.93	19.77	19.19	18.53	18.01	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.94	0.83	0.63	0.44	0.5	0.8	0.96	0.99	1	(94)

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

(95)m=	523.09	612.47	703.26	783.39	765.89	580.25	382.34	399.55	558.96	569.77	513.36	493.23	(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=	1663.14	1612.88	1462.99	1220.19	938.27	614.4	387.21	408.74	662.6	1013.7	1356.57	1649.99	(97)

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

(98)m=	848.2	672.28	565.24	314.49	128.25	0	0	0	0	330.28	607.11	860.63	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4326.49 (98)

Space heating requirement in kWh/m²/year 47.28 (99)

DER WorkSheet: New dwelling design stage

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

Space heating:

Fraction of space heat from secondary/supplementary system		0 (201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1 (202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1 (204)
Efficiency of main space heating system 1		90.2 (206)
Efficiency of secondary/supplementary heating system, %		0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)												
848.2	672.28	565.24	314.49	128.25	0	0	0	0	330.28	607.11	860.63	

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

940.35	745.32	626.65	348.66	142.19	0	0	0	0	366.17	673.07	954.13	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 4796.55 (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)

192.49	169.33	177.04	157.61	153.66	136.17	129.7	143.81	144.02	163.49	174.25	187.49	

Efficiency of water heater 87 (216)

(217)m=	89.59	89.54	89.42	89.11	88.43	87	87	87	87	89.11	89.47	89.61	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	214.85	189.11	198	176.88	173.78	156.52	149.08	165.3	165.54	183.47	194.77	209.23	

Total = Sum(219a)$_{1...12}$ = 2176.52 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		4796.55
Water heating fuel used		2176.52
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		380.71 (232)
Electricity generated by PVs		-803.2 (233)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year
Space heating (main system 1)	(211) x		0.216	=	1036.05 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)
Water heating	(219) x		0.216	=	470.13 (264)

DER WorkSheet: New dwelling design stage

Space and water heating	(261) + (262) + (263) + (264) =			1506.18	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	197.59	(268)
Energy saving/generation technologies Item 1		0.519	=	-416.86	(269)
Total CO2, kg/year	sum of (265)…(271) =			1325.84	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			14.49	(273)
EI rating (section 14)				87	(274)

TER WorkSheet: New dwelling design stage

User Details:

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

Property Address: Plot 21

Address : Plot 21, Land off Wardentree Lane, Spalding

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	45.75	(1a) x	2.38	(2a) =	108.89	(3a)
Ground floor	45.75	(1b) x	2.62	(2b) =	119.86	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	91.5	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		228.75	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.13	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.38	(21)

Infiltration rate modified for monthly wind speed

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

TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.49	0.48	0.47	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.45

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0

(24a)

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

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0

(24b)

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0

(24c)

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

(24d)m=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6

(24d)

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

(25)m=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6

(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.12	x	1.2	=	2.544			(26)
Windows Type 1			1.62	x1/[1/(1.4)+ 0.04]		=	2.15			(27)
Windows Type 2			1.62	x1/[1/(1.4)+ 0.04]		=	2.15			(27)
Windows Type 3			0.66	x1/[1/(1.4)+ 0.04]		=	0.88			(27)
Windows Type 4			3.38	x1/[1/(1.4)+ 0.04]		=	4.48			(27)
Windows Type 5			0.66	x1/[1/(1.4)+ 0.04]		=	0.88			(27)
Windows Type 6			1.26	x1/[1/(1.4)+ 0.04]		=	1.67			(27)
Windows Type 7			2.52	x1/[1/(1.4)+ 0.04]		=	3.34			(27)
Windows Type 8			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 9			0.66	x1/[1/(1.4)+ 0.04]		=	0.88			(27)
Windows Type 10			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 11			1.1	x1/[1/(1.4)+ 0.04]		=	1.46			(27)
Windows Type 12			1.1	x1/[1/(1.4)+ 0.04]		=	1.46			(27)
Windows Type 13			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Floor			45.75	x	0.13	=	5.9475			(28)
Walls	97.05	21.02	76.03	x	0.18	=	13.69			(29)
Roof	46.94	0	46.94	x	0.13	=	6.1			(30)

TER WorkSheet: New dwelling design stage

Total area of elements, m²	189.74					(31)
Party wall	40.2	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) = 53.34 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10224.51 (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 10.28 (36)

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

Total fabric heat loss (33) + (36) = 63.62 (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=	46.66	46.31	45.97	44.38	44.08	42.69	42.69	42.44	43.23	44.08	44.68	45.31	(38)

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

(39)m=	110.28	109.93	109.59	108	107.7	106.31	106.31	106.05	106.85	107.7	108.3	108.93	

Average = Sum(39)$_{1...12}$ /12= 108 (39)

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

(40)m=	1.21	1.2	1.2	1.18	1.18	1.16	1.16	1.16	1.17	1.18	1.18	1.19	

Average = Sum(40)$_{1...12}$ /12= 1.18 (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 2.65 (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 97.04 (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=	106.74	102.86	98.98	95.09	91.21	87.33	87.33	91.21	95.09	98.98	102.86	106.74	

Total = Sum(44)$_{1...12}$ = 1164.42 (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=	158.29	138.44	142.86	124.55	119.51	103.13	95.56	109.66	110.97	129.32	141.17	153.3	

Total = Sum(45)$_{1...12}$ = 1526.74 (45)

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

(46)m=	23.74	20.77	21.43	18.68	17.93	15.47	14.33	16.45	16.65	19.4	21.17	22.99	(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:

TER WorkSheet: New dwelling design stage

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=	50.96	46.03	50.44	46.9	46.48	43.07	44.5	46.48	46.9	50.44	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=	209.25	184.47	193.3	171.44	165.99	146.19	140.06	156.14	157.86	179.76	190.48	204.26	(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=	209.25	184.47	193.3	171.44	165.99	146.19	140.06	156.14	157.86	179.76	190.48	204.26	

Output from water heater (annual)$_{1...12}$: 2099.2 (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=	65.37	57.54	60.11	53.14	51.36	45.06	42.9	48.08	48.62	55.61	59.27	63.71	(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=	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	132.29	(66)

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

(67)m=	21.56	19.15	15.57	11.79	8.81	7.44	8.04	10.45	14.02	17.81	20.78	22.16	(67)

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

(68)m=	241.81	244.32	238	224.54	207.54	191.57	180.9	178.39	184.72	198.18	215.17	231.14	(68)

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

(69)m=	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	36.23	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

TER WorkSheet: New dwelling design stage

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	-105.83	(71)

Water heating gains (Table 5)

(72)m=	87.86	85.62	80.79	73.8	69.03	62.58	57.66	64.63	67.53	74.74	82.31	85.63	(72)

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

(73)m=	416.92	414.78	400.05	375.81	351.07	327.28	312.29	319.15	331.96	356.41	383.95	404.62	(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	1.62	x	11.28	x	0.63	x	0.7	=	5.59	(75)
Northeast 0.9x	0.77	x	1.62	x	11.28	x	0.63	x	0.7	=	5.59	(75)
Northeast 0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	1.62	x	22.97	x	0.63	x	0.7	=	11.37	(75)
Northeast 0.9x	0.77	x	1.62	x	22.97	x	0.63	x	0.7	=	11.37	(75)
Northeast 0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	1.62	x	41.38	x	0.63	x	0.7	=	20.49	(75)
Northeast 0.9x	0.77	x	1.62	x	41.38	x	0.63	x	0.7	=	20.49	(75)
Northeast 0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	1.62	x	67.96	x	0.63	x	0.7	=	33.64	(75)
Northeast 0.9x	0.77	x	1.62	x	67.96	x	0.63	x	0.7	=	33.64	(75)
Northeast 0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	1.62	x	91.35	x	0.63	x	0.7	=	45.22	(75)
Northeast 0.9x	0.77	x	1.62	x	91.35	x	0.63	x	0.7	=	45.22	(75)
Northeast 0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)
Northeast 0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)

TER WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	1.62	x	97.38	x	0.63	x	0.7	=	48.21	(75)
Northeast	0.9x	0.77	x	1.62	x	97.38	x	0.63	x	0.7	=	48.21	(75)
Northeast	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(75)
Northeast	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(75)
Northeast	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast	0.9x	0.77	x	1.62	x	91.1	x	0.63	x	0.7	=	45.1	(75)
Northeast	0.9x	0.77	x	1.62	x	91.1	x	0.63	x	0.7	=	45.1	(75)
Northeast	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(75)
Northeast	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(75)
Northeast	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast	0.9x	0.77	x	1.62	x	72.63	x	0.63	x	0.7	=	35.96	(75)
Northeast	0.9x	0.77	x	1.62	x	72.63	x	0.63	x	0.7	=	35.96	(75)
Northeast	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(75)
Northeast	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(75)
Northeast	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast	0.9x	0.77	x	1.62	x	50.42	x	0.63	x	0.7	=	24.96	(75)
Northeast	0.9x	0.77	x	1.62	x	50.42	x	0.63	x	0.7	=	24.96	(75)
Northeast	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast	0.9x	0.77	x	1.62	x	28.07	x	0.63	x	0.7	=	13.9	(75)
Northeast	0.9x	0.77	x	1.62	x	28.07	x	0.63	x	0.7	=	13.9	(75)
Northeast	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	1.62	x	14.2	x	0.63	x	0.7	=	7.03	(75)
Northeast	0.9x	0.77	x	1.62	x	14.2	x	0.63	x	0.7	=	7.03	(75)
Northeast	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	1.62	x	9.21	x	0.63	x	0.7	=	4.56	(75)
Northeast	0.9x	0.77	x	1.62	x	9.21	x	0.63	x	0.7	=	4.56	(75)
Northeast	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(75)
Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Northeast	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(75)

TER WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Southeast	0.9x	0.77	x	3.38	x	36.79	x	0.63	x	0.7	=	38.01	(77)
Southeast	0.9x	0.77	x	1.1	x	36.79	x	0.63	x	0.7	=	12.37	(77)
Southeast	0.9x	0.77	x	1.1	x	36.79	x	0.63	x	0.7	=	12.37	(77)
Southeast	0.9x	0.77	x	3.38	x	62.67	x	0.63	x	0.7	=	64.74	(77)
Southeast	0.9x	0.77	x	1.1	x	62.67	x	0.63	x	0.7	=	21.07	(77)
Southeast	0.9x	0.77	x	1.1	x	62.67	x	0.63	x	0.7	=	21.07	(77)
Southeast	0.9x	0.77	x	3.38	x	85.75	x	0.63	x	0.7	=	88.58	(77)
Southeast	0.9x	0.77	x	1.1	x	85.75	x	0.63	x	0.7	=	28.83	(77)
Southeast	0.9x	0.77	x	1.1	x	85.75	x	0.63	x	0.7	=	28.83	(77)
Southeast	0.9x	0.77	x	3.38	x	106.25	x	0.63	x	0.7	=	109.75	(77)
Southeast	0.9x	0.77	x	1.1	x	106.25	x	0.63	x	0.7	=	35.72	(77)
Southeast	0.9x	0.77	x	1.1	x	106.25	x	0.63	x	0.7	=	35.72	(77)
Southeast	0.9x	0.77	x	3.38	x	119.01	x	0.63	x	0.7	=	122.93	(77)
Southeast	0.9x	0.77	x	1.1	x	119.01	x	0.63	x	0.7	=	40.01	(77)
Southeast	0.9x	0.77	x	1.1	x	119.01	x	0.63	x	0.7	=	40.01	(77)
Southeast	0.9x	0.77	x	3.38	x	118.15	x	0.63	x	0.7	=	122.05	(77)
Southeast	0.9x	0.77	x	1.1	x	118.15	x	0.63	x	0.7	=	39.72	(77)
Southeast	0.9x	0.77	x	1.1	x	118.15	x	0.63	x	0.7	=	39.72	(77)
Southeast	0.9x	0.77	x	3.38	x	113.91	x	0.63	x	0.7	=	117.67	(77)
Southeast	0.9x	0.77	x	1.1	x	113.91	x	0.63	x	0.7	=	38.29	(77)
Southeast	0.9x	0.77	x	1.1	x	113.91	x	0.63	x	0.7	=	38.29	(77)
Southeast	0.9x	0.77	x	3.38	x	104.39	x	0.63	x	0.7	=	107.83	(77)
Southeast	0.9x	0.77	x	1.1	x	104.39	x	0.63	x	0.7	=	35.09	(77)
Southeast	0.9x	0.77	x	1.1	x	104.39	x	0.63	x	0.7	=	35.09	(77)
Southeast	0.9x	0.77	x	3.38	x	92.85	x	0.63	x	0.7	=	95.91	(77)
Southeast	0.9x	0.77	x	1.1	x	92.85	x	0.63	x	0.7	=	31.21	(77)
Southeast	0.9x	0.77	x	1.1	x	92.85	x	0.63	x	0.7	=	31.21	(77)
Southeast	0.9x	0.77	x	3.38	x	69.27	x	0.63	x	0.7	=	71.55	(77)
Southeast	0.9x	0.77	x	1.1	x	69.27	x	0.63	x	0.7	=	23.29	(77)
Southeast	0.9x	0.77	x	1.1	x	69.27	x	0.63	x	0.7	=	23.29	(77)
Southeast	0.9x	0.77	x	3.38	x	44.07	x	0.63	x	0.7	=	45.52	(77)
Southeast	0.9x	0.77	x	1.1	x	44.07	x	0.63	x	0.7	=	14.82	(77)
Southeast	0.9x	0.77	x	1.1	x	44.07	x	0.63	x	0.7	=	14.82	(77)
Southeast	0.9x	0.77	x	3.38	x	31.49	x	0.63	x	0.7	=	32.53	(77)
Southeast	0.9x	0.77	x	1.1	x	31.49	x	0.63	x	0.7	=	10.59	(77)
Southeast	0.9x	0.77	x	1.1	x	31.49	x	0.63	x	0.7	=	10.59	(77)
Southwest	0.9x	0.77	x	0.66	x	36.79		0.63	x	0.7	=	7.42	(79)
Southwest	0.9x	0.77	x	0.66	x	62.67		0.63	x	0.7	=	12.64	(79)
Southwest	0.9x	0.77	x	0.66	x	85.75		0.63	x	0.7	=	17.3	(79)
Southwest	0.9x	0.77	x	0.66	x	106.25		0.63	x	0.7	=	21.43	(79)

TER WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	0.66	x	119.01		0.63	x	0.7	=	24	(79)
Southwest	0.9x	0.77	x	0.66	x	118.15		0.63	x	0.7	=	23.83	(79)
Southwest	0.9x	0.77	x	0.66	x	113.91		0.63	x	0.7	=	22.98	(79)
Southwest	0.9x	0.77	x	0.66	x	104.39		0.63	x	0.7	=	21.06	(79)
Southwest	0.9x	0.77	x	0.66	x	92.85		0.63	x	0.7	=	18.73	(79)
Southwest	0.9x	0.77	x	0.66	x	69.27		0.63	x	0.7	=	13.97	(79)
Southwest	0.9x	0.77	x	0.66	x	44.07		0.63	x	0.7	=	8.89	(79)
Southwest	0.9x	0.77	x	0.66	x	31.49		0.63	x	0.7	=	6.35	(79)
Northwest	0.9x	0.77	x	1.26	x	11.28	x	0.63	x	0.7	=	4.34	(81)
Northwest	0.9x	0.77	x	2.52	x	11.28	x	0.63	x	0.7	=	8.69	(81)
Northwest	0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(81)
Northwest	0.9x	0.77	x	1.26	x	22.97	x	0.63	x	0.7	=	8.84	(81)
Northwest	0.9x	0.77	x	2.52	x	22.97	x	0.63	x	0.7	=	17.69	(81)
Northwest	0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(81)
Northwest	0.9x	0.77	x	1.26	x	41.38	x	0.63	x	0.7	=	15.93	(81)
Northwest	0.9x	0.77	x	2.52	x	41.38	x	0.63	x	0.7	=	31.87	(81)
Northwest	0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(81)
Northwest	0.9x	0.77	x	1.26	x	67.96	x	0.63	x	0.7	=	26.17	(81)
Northwest	0.9x	0.77	x	2.52	x	67.96	x	0.63	x	0.7	=	52.34	(81)
Northwest	0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(81)
Northwest	0.9x	0.77	x	1.26	x	91.35	x	0.63	x	0.7	=	35.17	(81)
Northwest	0.9x	0.77	x	2.52	x	91.35	x	0.63	x	0.7	=	70.35	(81)
Northwest	0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(81)
Northwest	0.9x	0.77	x	1.26	x	97.38	x	0.63	x	0.7	=	37.5	(81)
Northwest	0.9x	0.77	x	2.52	x	97.38	x	0.63	x	0.7	=	75	(81)
Northwest	0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(81)
Northwest	0.9x	0.77	x	1.26	x	91.1	x	0.63	x	0.7	=	35.08	(81)
Northwest	0.9x	0.77	x	2.52	x	91.1	x	0.63	x	0.7	=	70.16	(81)
Northwest	0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(81)
Northwest	0.9x	0.77	x	1.26	x	72.63	x	0.63	x	0.7	=	27.97	(81)
Northwest	0.9x	0.77	x	2.52	x	72.63	x	0.63	x	0.7	=	55.93	(81)
Northwest	0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(81)
Northwest	0.9x	0.77	x	1.26	x	50.42	x	0.63	x	0.7	=	19.42	(81)
Northwest	0.9x	0.77	x	2.52	x	50.42	x	0.63	x	0.7	=	38.83	(81)
Northwest	0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(81)
Northwest	0.9x	0.77	x	1.26	x	28.07	x	0.63	x	0.7	=	10.81	(81)
Northwest	0.9x	0.77	x	2.52	x	28.07	x	0.63	x	0.7	=	21.62	(81)
Northwest	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(81)
Northwest	0.9x	0.77	x	1.26	x	14.2	x	0.63	x	0.7	=	5.47	(81)
Northwest	0.9x	0.77	x	2.52	x	14.2	x	0.63	x	0.7	=	10.93	(81)
Northwest	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(81)

TER WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	1.26	x	9.21	x	0.63	x	0.7	=	3.55	(81)
Northwest 0.9x	0.77	x	2.52	x	9.21	x	0.63	x	0.7	=	7.1	(81)
Northwest 0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(81)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m=	113.82	208.38	323.63	465.55	580.38	602.1	569.7	480.07	372.15	240.69	138.97	95.7	(83)

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

(84)m=	530.74	623.16	723.68	841.36	931.45	929.38	881.99	799.23	704.11	597.1	522.93	500.31	(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	0.96	0.86	0.68	0.52	0.59	0.85	0.98	1	1	(86)

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

(87)m=	19.67	19.83	20.11	20.49	20.8	20.95	20.99	20.98	20.86	20.45	20	19.64	(87)

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

(88)m=	19.92	19.92	19.92	19.94	19.94	19.95	19.95	19.95	19.95	19.94	19.93	19.93	(88)

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

(89)m=	1	0.99	0.98	0.94	0.81	0.59	0.4	0.47	0.78	0.97	0.99	1	(89)

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

(90)m=	18.14	18.38	18.79	19.34	19.74	19.92	19.95	19.95	19.83	19.3	18.63	18.12	(90)

fLA = Living area ÷ (4) = 0.2 (91)

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

(92)m=	18.44	18.67	19.05	19.56	19.95	20.13	20.15	20.15	20.04	19.53	18.9	18.42	(92)

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

(93)m=	18.44	18.67	19.05	19.56	19.95	20.13	20.15	20.15	20.04	19.53	18.9	18.42	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.93	0.81	0.61	0.42	0.49	0.79	0.96	0.99	1	(94)

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

(95)m=	528.84	618.19	708.25	784.11	755.65	563.97	374.69	391.67	553.47	574.17	519.08	498.96	(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=	1559.76	1513.81	1375.68	1151.72	888.54	587.44	377.87	397.9	634.21	961.49	1278.44	1549.02	(97)

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

(98)m=	767.01	601.86	496.56	264.68	98.87	0	0	0	0	288.17	546.74	781.24	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3845.12 (98)

Space heating requirement in kWh/m²/year 42.02 (99)

TER WorkSheet: New dwelling design stage

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)													
	767.01	601.86	496.56	264.68	98.87	0	0	0	0	288.17	546.74	781.24	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	821.21	644.39	531.65	283.38	105.86	0	0	0	0	308.53	585.38	836.44	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 4116.83 (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)

	209.25	184.47	193.3	171.44	165.99	146.19	140.06	156.14	157.86	179.76	190.48	204.26

Efficiency of water heater 80.3 (216)

(217)m=	88.03	87.81	87.32	86.14	83.79	80.3	80.3	80.3	80.3	86.23	87.55	88.1	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	237.71	210.08	221.36	199.03	198.09	182.06	174.43	194.44	196.59	208.46	217.56	231.84	

Total = Sum(219a)$_{1...12}$ = 2471.64 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		4116.83
Water heating fuel used		2471.64
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		380.71 (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 =	889.24 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	533.87 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1423.11 (265)

TER WorkSheet: New dwelling design stage

Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	197.59	(268)
Total CO2, kg/year			sum of (265)…(271) =		1659.63	(272)

TER = 18.14 (273)

SAP 2012 Overheating Assessment

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

Property Details: Plot 21

Dwelling type:	Detached House
Located in:	England
Region:	East Pennines
Cross ventilation possible:	Yes
Number of storeys:	2
Front of dwelling faces:	North 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):	4 (Windows open half the time)

Overheating Details:

Summer ventilation heat loss coefficient:	301.95	**(P1)**
Transmission heat loss coefficient:	72.4	
Summer heat loss coefficient:	374.3	**(P2)**

Overhangs:

Orientation:	Ratio:	Z_overhangs:
North East (Dining)	0	1
North East (Living Room)	0	1
North East (Living Bay 1)	0	1
South East (Living Bay 2)	0	1
South West (Living Bay 3)	0	1
North West (Kitchen)	0	1
North West (Dining)	0	1
North East (Bedroom 2)	0	1
North East (En Suite)	0	1
North East (Bedroom 1)	0	1
South East (Bedroom 1 2)	0	1
South East (Bath)	0	1
North West (Bedroom 3)	0	1

Solar shading:

Orientation:	Z blinds:	Solar access:	Overhangs:	Z summer:	
North East (Dining)	1	0.9	1	0.9	**(P8)**
North East (Living Room)	1	0.9	1	0.9	**(P8)**
North East (Living Bay 1)	1	0.9	1	0.9	**(P8)**
South East (Living Bay 2)	1	0.9	1	0.9	**(P8)**
South West (Living Bay 3)	1	0.9	1	0.9	**(P8)**
North West (Kitchen)	1	0.9	1	0.9	**(P8)**
North West (Dining)	1	0.9	1	0.9	**(P8)**
North East (Bedroom 2)	1	0.9	1	0.9	**(P8)**
North East (En Suite)	1	0.9	1	0.9	**(P8)**
North East (Bedroom 1)	1	0.9	1	0.9	**(P8)**
South East (Bedroom 1 2)	1	0.9	1	0.9	**(P8)**
South East (Bath)	1	0.9	1	0.9	**(P8)**
North West (Bedroom 3)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation	Area	Flux	g_	FF	Shading	Gains

SAP 2012 Overheating Assessment

North East (Dining)	0.9 x	1.62	91.1	0.63	0.7	0.9	52.72	
North East (Living Room)	0.9 x	1.62	91.1	0.63	0.7	0.9	52.72	
North East (Living Bay 1)	0.9 x	0.66	91.1	0.63	0.7	0.9	21.48	
South East (Living Bay 2)	0.9 x	3.38	113.91	0.63	0.7	0.9	137.53	
South West (Living Bay 3)	0.9 x	0.66	113.91	0.63	0.7	0.9	26.86	
North West (Kitchen)	0.9 x	1.26	91.1	0.63	0.7	0.9	41	
North West (Dining)	0.9 x	2.52	91.1	0.63	0.7	0.9	82.01	
North East (Bedroom 2)	0.9 x	1.44	91.1	0.63	0.7	0.9	46.86	
North East (En Suite)	0.9 x	0.66	91.1	0.63	0.7	0.9	21.48	
North East (Bedroom 1)	0.9 x	1.44	91.1	0.63	0.7	0.9	46.86	
South East (Bedroom 1 2)	0.9 x	1.1	113.91	0.63	0.7	0.9	44.76	
South East (Bath)	0.9 x	1.1	113.91	0.63	0.7	0.9	44.76	
North West (Bedroom 3)	0.9 x	1.44	91.1	0.63	0.7	0.9	46.86	
						Total	665.89	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	470.06	450.71	459.3	
Total summer gains	1173.81	1116.6	1020.42	**(P5)**
Summer gain/loss ratio	3.14	2.98	2.73	**(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	17.99	19.83	19.38	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant