Building Regulation Compliance

Property Reference: 502 Linton House
Survey Reference: 502 design
Property: 502, London

Issued on Date: 01.Nov.2016
Prop Type Ref:

SAP Rating:	82 B	**CO2 Emissions (t/year):**	2.09	**DER:**	16.66 Pass	**TER:**	22.69	**Percentage DER<TER:**	26.58 %
Environmental:	84 B	**General Requirements Compliance:**	Pass	**DFEE:**	49.17 Pass	**TFEE:**	55.74	**Percentage DFEE<TFEE:**	11.78 %

CfSH Results **Version:** November 2010 - June 2014 Addendum **ENE1 Credits:** 3.5 **ENE2 Credits:** 0.0 **ENE7 Credits:** 0 **CfSH Level:** 4

Surveyor: Mike Ovenden, Tel: 01908 850109 Surveyor ID: H824-0001
Address: Dudley Hill, Shenley Church End, Milton Keynes, Buckinghamshire, MK5 6LL
Client: Synergy, 3

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.06r08
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

SUMMARY FOR INPUT DATA FOR New Build (As Designed)

1a TER and DER

Fuel for main heating:	Electricity	
Fuel factor:	1.55 (electricity)	
Target Carbon Dioxide Emission Rate (TER)	22.69 kg/m^2	
Dwelling Carbon Dioxide Emission Rate (DER)	16.66 kg/m^2	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	55.74 kWh/m^2	
Dwelling Fabric Energy Efficiency (DFEE)	49.17 kWh/m^2	OK

2 Fabric U-values

Element	Average	Highest	
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings and curtain wall	0.74 (max. 2.00)	0.74 (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:	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
Secondary heating system:	None	

5 Cylinder insulation

Hot water storage	Nominal cylinder loss: 1.82 kWh/day Permitted by DBSCG 2.10	OK
Primary pipework insulated:	Yes	OK

6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings:	100%	
Minimum	75%	OK

8 Mechanical ventilation

Continuous supply and extract system
Specific fan power: 0.75

Maximum	1.5	OK
MVHR efficiency:	78%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based On:		
Overshading:	Average	
Windows facing South:	2.56 m^2, No overhang	
Windows facing West:	58.48 m^2, No overhang	
Air change rate:	8.00 ach	
Blinds/curtains:	None	

10 Key features

Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Roof U-value	0.10 W/m^2K
Roof U-value	0.10 W/m^2K
Window U-value	0.74 W/m^2K
Thermal bridging y-value	0.021 W/m^2K
Photovoltaic array	

Full SAP Calculation Printout

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Survey Reference: 502 design
Property: 502, London

Issued on Date: 01.Nov.2016
Prop Type Ref:

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Client: Synergy, 3

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.06r08
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

CALCULATION DETAILS for survey reference no '502 design'
SAP2012 - 9.92 input data (DesignData) -

SAP2012 Input Data (Flat)	01/11/2016
FullRefNo:	502 design
Regs Region:	England
SAP Region:	Thames Valley
Postcode:	
DwellingOrientation:	East
Property Type:	Flat, End-Terrace
Storeys:	2
Date Built:	2016
Sheltered Sides:	2
Sunlight Shade:	Average or unknown
Measurements	Perimeter, Floor Area, Storey Height
1st Storey:	26.03, 125.25, 2.6
2nd Storey:	15.77, 29.82, 2.85
Living Area:	42.66 m2, fraction: 27.5%
Thermal Mass:	Simple calculation
Thermal Mass Simple:	Low
Thermal MassValue:	100
External Walls	Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1	31.81, 67.66, 0, Other, CurtainWalling, 0, 0.74, Calculate
External Wall 2	19.77, 44.96, 0, Other, CurtainWalling, 0, 0.74, Gross
Party Walls	Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1	76.01, 20, PartyWallSteelFrame, Solid, 0, 0
Party Wall 2	26.69, 20, PartyWallSteelFrame, Solid, 0, 0
External Roofs	Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
penthouse roof	95.43, 95.43, 0, Other, 0.1
garden room roof	29.82, 29.82, 0, Other, 0.1
Heat Loss Floors	Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
penthouse floor	125.25, 0, Other, Ground Floor - Solid, 0, 0.15
Description	Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Opening Type 1	Manufacturer, Window, Double Low-E Soft 0.05, , , 0.36, , 1,
Openings	Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
1	Window, External Wall 1, West, , None, 0, , 0, 0, 0, 1.42,
2	Window, External Wall 1, West, , None, 0, , 0, 0, 0, 9.05,
3	Window, External Wall 1, West, , None, 0, , 0, 0, 0, 7.29,
4	Window, External Wall 1, West, , None, 0, , 0, 0, 0, 7.29,
5	Window, External Wall 1, West, , None, 0, , 0, 0, 0, 8.24,
1gh	Window, External Wall 2, West, , None, 0, , 0, 0, 0, 24.14,
6	Window, External Wall 1, South, , None, 0, , 0, 0, 0, 1.28,
7	Window, External Wall 1, South, , None, 0, , 0, 0, 0, 1.28,
2gh	Window, External Wall 2, West, , None, 0, , 0, 0, 0, 1.05,
Conservatory:	None
Draught Proofing:	100
Draught Lobby:	No
Thermal Bridges	
Bridging:	Calculate Bridges
Y	0.021
List of Bridges	Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
0.	External wall, E1 Steel lintel with perforated steel base plate, , No, 0, 0, 0, 0.00,
1.	External wall, E2 Other lintels (including other steel lintels), , No, 0, 0, 0, 0.00,
2.	External wall, E3 Sill, , No, 0, 0, 0, 0.00,
3.	External wall, E4 Jamb, , No, 0, 0, 0, 0.00,
4.	External wall, E5 Ground floor (normal), , No, 0, 0, 0, 0.00,
5.	External wall, E19 Ground floor (inverted), Table K1 - Default, No, 26.03, 0.07, 0.07, 1.82,
6.	External wall, E20 Exposed floor (normal), , No, 0, 0, 0, 0.00,
7.	External wall, E21 Exposed floor (inverted), , No, 0, 0, 0, 0.00,
8.	External wall, E22 Basement floor, , No, 0, 0, 0, 0.00,
9.	External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, Yes, 15.77, 0.07, 0.07, 1.10,
10.	External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, Yes, 26.03, 0.07, 0.07, 1.82,
11.	External wall, E8 Balcony within a dwelling, wall insulation continuous, , No, 0, 0, 0, 0.00,
12.	External wall, E9 Balcony between dwellings, wall insulation continuous, , No, 0, 0, 0, 0.00,
13.	External wall, E23 Balcony within or between dwellings, balcony support penetrates wall insulation , , No, 0, 0, 0, 0.00,
14.	External wall, E10 Eaves (insulation at ceiling level), , No, 0, 0, 0, 0.00,
15.	External wall, E24 Eaves (insulation at ceiling level - inverted), , No, 0, 0, 0, 0.00,
16.	External wall, E11 Eaves (insulation at rafter level), , No, 0, 0, 0, 0.00,
17.	External wall, E12 Gable (insulation at ceiling level), , No, 0, 0, 0, 0.00,
18.	External wall, E13 Gable (insulation at rafter level), , No, 0, 0, 0, 0.00,
19.	External wall, E14 Flat roof, Table K1 - Default, Yes, 15.77, 0.08, 0.08, 1.26,
20.	External wall, E15 Flat roof with parapet, , No, 0, 0, 0, 0.00,
21.	External wall, E16 Corner (normal), Table K1 - Approved, Yes, 10.9, 0.09, 0.09, 0.98,
22.	External wall, E17 Corner (inverted - internal area greater than external area), , No, 0, 0, 0, 0.00,
23.	External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 10.9, 0.06, 0.06, 0.65,
24.	External wall, E25 Staggered party wall between dwellings, , No, 0, 0, 0, 0.00,
25.	Party wall, P1 Party wall - Ground floor, , No, 0, 0, 0, 0.00,
26.	Party wall, P6 Party wall - Ground floor (inverted), , No, 0, 0, 0, 0.00,
27.	Party wall, P2 Party wall - Intermediate floor within a dwelling, , No, 0, 0, 0, 0.00,
28.	Party wall, P3 Party wall - Intermediate floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,

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    29.                     Party wall, P7 Party Wall - Exposed floor (normal), , No, 0, 0, 0, 0.00,
    30.                     Party wall, P8 Party Wall - Exposed floor (inverted), , No, 0, 0, 0, 0.00,
    31.                     Party wall, P4 Party wall - Roof (insulation at ceiling level), , No, 0, 0, 0, 0.00,
    32.                     Party wall, P5 Party wall - Roof (insulation at rafter level), , No, 0, 0, 0, 0.00,
    33.                     External roof, R1 Head of roof window, , No, 0, 0, 0, 0.00,
    34.                     External roof, R2 Sill of roof window, , No, 0, 0, 0, 0.00,
    35.                     External roof, R3 Jamb of roof window, , No, 0, 0, 0, 0.00,
    36.                     External roof, R4 Ridge (vaulted ceiling), , No, 0, 0, 0, 0.00,
    37.                     External roof, R5 Ridge (inverted), , No, 0, 0, 0, 0.00,
    38.                     External roof, R6 Flat ceiling, , No, 0, 0, 0, 0.00,
    39.                     External roof, R7 Flat ceiling (inverted), , No, 0, 0, 0, 0.00,
    40.                     External roof, R8 Roof to wall (rafter), , No, 0, 0, 0, 0.00,
    41.                     External roof, R9 Roof to wall (flat ceiling), , No, 0, 0, 0, 0.00,
Pressure Test:               True
Designed q50:                5
AsBuilt q50:                 15
Property Tested:             False
Mechanical Ventilation
    MV System Present        Yes
    Windows In Hot Weather   Windows fully open
    Cross Ventilation        Yes
    Night Ventilation        No
    Air Change Rate          8.00
    Approved Installation    Yes
    DataType                 Database
    Type                     Balanced mechanical ventilation with heat recovery
    Database Ref Number      500320
    Configuration            3
    HR Duct Insulated        No
    ManufacturerSFP          0.75
    DuctType                 Rigid
    HR Efficiency            78
    Wet Rooms                3
Chimneys MHS:                0
Chimneys SHS:                0
Chimneys Other:              0
Chimneys Total:              0
Open Flues MHS:              0
Open Flues SHS:              0
Open Flues Other:            0
Open Flues Total:            0
Intermittent Fans:           0
Passive Vents:               0
Flueless Gas Fires:          0
Cooling System
    Cooled Area              155.07
    Data Source              SAP table
    Type                     Split or Multi-Split
    Class                    A
    Control                  On/Off
Light Fittings:              52
LEL Fittings:                52
Percentage of LEL Fittings:  100
External Lights Fitted:      Yes
External LELs Fitted:        Yes
Electricity Tariff:          Standard
Main Heating 1
    Description              ashp
    Percentage               100
    MHS                      Electricity PET Heat pump air-to-water
    SAP Code                 224
    Boiler Efficiency Type   SAP Table
    Efficiency               170
    Controls by PCDF         0
    MHS Controls             CHD Time and temperature zone control
    Boiler Interlock         No
    Ctrl SAP Code            2207
    MCS Installation CertificateNo
    Pumped                   Pump in heated space
    Heat Pump Age            2013 or later
    Heat Emitter             Radiators and Underfloor
    Flow Temperature         <= 35°C
    Under Floor Heating      Yes - Pipes in thin screed
Main Heating 2               None
Heating Systems Interaction  Each system heats separate parts of dwelling
Smoke Control Area           Unknown
Community Heating            None
Secondary Heating            None
Water Heating
    Type                     MainHeating1
    WHS                      HWP From main heating 1
    Low Water Usage          Yes
    SAP Code                 901
    Showers in Property      Non-electric only
    Suplementary Immersion   No
    Hot Water Cylinder
    Cylinder Type            HotWaterCylinder
    Cylinder Insulation Type Foam
    Cylinder Volume          180.00
    Cylinder Stat            Yes
    Pipeworks Insulated      Fully insulated primary pipework
    Cylinder in Heated Space Yes
    Separate Time Control    Yes
Flue Gas Heat Recovery System None
Waste Water Heat Recovery    none
PV Unit
Type                         One Dwelling
PVUnit 1                     Cells Peak = 1.31, Orientation = South, Elevation = 30°, Overshading = None Or Little, , Connected to Dwelling = Yes
Wind Turbine                 None
Terrain Type:                Urban
Small Scale Hydro            None
Special Features             None


-------------------------------------------------------------------------------------------------
REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Top-floor flat, total floor area 155 m²
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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:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 22.69 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.66 kg/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.7 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)49.2 kWh/m²OK

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2 Fabric U-values

Element	Average	Highest	
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings and curtain wall	0.74 (max. 2.00)	0.74 (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: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage Nominal cylinder loss: 1.82 kWh/day
Permitted by DBSCG 2.10 OK
Primary pipework insulated: Yes OK

---

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

---

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---

8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.75
Maximum 1.5 OK
MVHR efficiency: 78%
Minimum: 70% OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South: 2.56 m², No overhang
Windows facing West: 58.48 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

---

10 Key features
Party wall U-value 0.00 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Roof U-value 0.10 W/m²K
Window U-value 0.74 W/m²K
Thermal bridging y-value 0.021 W/m²K
Photovoltaic array

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	125.2500 (1b)	x	2.6000 (2b)	=	325.6500 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	155.0700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	410.6370	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.2500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	54.6000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.4979	0.4926	0.4873	0.4608	0.4554	0.4289	0.4289	0.4236	0.4395	0.4554	0.4661	0.4767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 0.74)			61.0400	0.7187	43.8710			(27)
penthouse floor			125.2500	0.1500	18.7875			(28a)
External Wall 1	67.6600	35.8500	31.8100	0.7400	23.5394			(29a)
External Wall 2	44.9600	25.1900	19.7700	0.7400	14.6298			(29a)
penthouse roof	95.4300		95.4300	0.1000	9.5430			(30)
garden room roof	29.8200		29.8200	0.1000	2.9820			(30)
Total net area of external elements Aum(A, m2)			363.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		113.3527			(33)
Party Wall 1			76.0100	0.0000	0.0000			(32)
Party Wall 2			26.6900	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.6447 (36)
Total fabric heat loss (33) + (36) =	120.9974 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	67.4756	66.7557	66.0358	62.4363	61.7164	58.1169	58.1169	57.3970	59.5567	61.7164	63.1562	64.5960	(38)
Heat transfer coeff	188.4730	187.7531	187.0332	183.4337	182.7138	179.1144	179.1144	178.3945	180.5542	182.7138	184.1536	185.5934	(39)

Average = Sum(39)m / 12 = 183.2538 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2154	1.2108	1.2061	1.1829	1.1783	1.1551	1.1551	1.1504	1.1643	1.1783	1.1876	1.1968	(40)
HLP (average)												1.1817	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9418 (42)
Average daily hot water use (litres/day)	104.0688 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.4756	110.3129	106.1501	101.9874	97.8246	93.6619	93.6619	97.8246	101.9874	106.1501	110.3129	114.4756	(44)
Energy conte	169.7641	148.4767	153.2147	133.5763	128.1696	110.6006	102.4877	117.6062	119.0108	138.6956	151.3971	164.4074	(45)
Energy content (annual)											Total = Sum(45)m =	1637.4068	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4646	22.2715	22.9822	20.0364	19.2254	16.5901	15.3732	17.6409	17.8516	20.8043	22.7096	24.6611	(46)

Water storage loss:	
Store volume	180.0000 (47)
b) If manufacturer declared loss factor is not known :	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115 (51)
Volume factor from Table 2a	0.8736 (52)
Temperature factor from Table 2b	0.5400 (53)

Enter (49) or (54) in (55) 0.9805 (55)
Total storage loss
30.3965 27.4549 30.3965 29.4160 30.3965 29.4160 30.3965 30.3965 29.4160 30.3965 29.4160 30.3965 (56)
If cylinder contains dedicated solar storage
30.3965 27.4549 30.3965 29.4160 30.3965 29.4160 30.3965 30.3965 29.4160 30.3965 29.4160 30.3965 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
223.4229 196.9428 206.8736 185.5042 181.8285 162.5286 156.1466 171.2651 170.9387 192.3545 203.3250 218.0663 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
223.4229 196.9428 206.8736 185.5042 181.8285 162.5286 156.1466 171.2651 170.9387 192.3545 203.3250 218.0663 (64)
Total per year (kWh/year) = Sum(64)m = 2269.1969 (64)
Heat gains from water heating, kWh/month
99.3737 88.1414 93.8710 85.9565 85.5435 78.3171 77.0043 82.0312 81.1134 89.0434 91.8819 97.5926 (65)

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	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
29.0618 25.8124 20.9921 15.8924 11.8797 10.0294 10.8371 14.0864 18.9068 24.0065 28.0191 29.8695 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
325.9849 329.3676 320.8433 302.6961 279.7884 258.2585 243.8752 240.4925 249.0168 267.1640 290.0716 311.6016 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
37.7092 37.7092 37.7092 37.7092 37.7092 37.7092 37.7092 37.7092 37.7092 37.7092 37.7092 37.7092 (69)
Pumps, fans 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
-117.6737 -117.6737 -117.6737 -117.6737 -117.6737 -117.6737 -117.6737 -117.6737 -117.6737 -117.6737 -117.6737 -117.6737 (71)
Water heating gains (Table 5)
133.5667 131.1628 126.1707 119.3840 114.9778 108.7737 103.5004 110.2569 112.6576 119.6820 127.6137 131.1728 (72)
Total internal gains
558.7411 556.4704 538.1337 508.1000 476.7736 447.1892 428.3403 434.9635 450.7088 480.9801 515.8322 542.7715 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	2.5600	46.7521	0.3600	1.0000	0.7700	29.8591	(78)
West	58.4800	19.6403	0.3600	1.0000	0.7700	286.5434	(80)

Solar gains	316.4025	609.4412	985.4208	1416.7319	1723.3409	1759.6477	1677.0229	1448.2747	1138.7084	717.8724	392.6791	261.4404	(83)
Total gains	875.1435	1165.9116	1523.5545	1924.8320	2200.1145	2206.8370	2105.3632	1883.2382	1589.4172	1198.8526	908.5113	804.2119	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	22.8547	22.9424	23.0307	23.4826	23.5751	24.0489	24.0489	24.1459	23.8571	23.5751	23.3908	23.2093	
alpha	2.5236	2.5295	2.5354	2.5655	2.5717	2.6033	2.6033	2.6097	2.5905	2.5717	2.5594	2.5473	
util living area	0.9711	0.9428	0.8832	0.7687	0.6222	0.4693	0.3556	0.4061	0.6292	0.8601	0.9533	0.9763	(86)
MIT	18.9525	19.2662	19.7362	20.2633	20.6130	20.8016	20.8631	20.8491	20.6851	20.1521	19.4506	18.9112	(87)
Th 2	19.9077	19.9114	19.9151	19.9337	19.9374	19.9561	19.9561	19.9599	19.9486	19.9374	19.9300	19.9225	(88)
util rest of house	0.9666	0.9342	0.8662	0.7374	0.5744	0.4052	0.2776	0.3239	0.5639	0.8325	0.9448	0.9725	(89)
MIT 2	17.1587	17.6129	18.2838	19.0240	19.4824	19.7228	19.7843	19.7775	19.5960	18.8974	17.8973	17.1085	(90)
Living area fraction									fLA = Living area / (4) =			0.2751	(91)
MIT	17.6522	18.0677	18.6833	19.3650	19.7934	20.0196	20.0811	20.0723	19.8956	19.2426	18.3246	17.6044	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6522	18.0677	18.6833	19.3650	19.7934	20.0196	20.0811	20.0723	19.8956	19.2426	18.3246	17.6044	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9535	0.9151	0.8427	0.7186	0.5675	0.4092	0.2873	0.3331	0.5603	0.8106	0.9278	0.9612	(94)
Useful gains	834.4552	1066.9080	1283.8521	1383.1085	1248.5412	903.1223	604.8001	627.3504	890.6223	971.8473	842.8870	772.9889	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2516.5214	2472.2844	2278.6880	1919.6302	1478.7811	970.7312	623.5061	655.1212	1046.4225	1579.1174	2067.0507	2487.7763	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1251.4573	944.4130	740.1579	386.2956	171.2985	0.0000	0.0000	0.0000	0.0000	451.8090	881.3979	1275.8019	(98)
Space heating												6102.6310	(98)
Space heating per m2										(98) / (4) =		39.3540	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1683.6750	1325.4463	1355.7979	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8645	0.9048	0.8797	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1455.5814	1199.2625	1192.7464	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2690.4684	2569.1723	2311.6354	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	889.1187	1019.2128	832.4534	0.0000	0.0000	0.0000	0.0000	(104)

Space cooling 2740.7850 (104)
Cooled fraction fC = cooled area / (4) = 1.0000 (105)
Intermittency factor (Table 10b)

0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	222.2797	254.8032	208.1134	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling 685.1962 (107)
Space cooling per m2 4.4186 (108)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 170.0000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3589.7829 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.0000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1251.4573	944.4130	740.1579	386.2956	171.2985	0.0000	0.0000	0.0000	0.0000	451.8090	881.3979	1275.8019	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	736.1513	555.5371	435.3870	227.2327	100.7638	0.0000	0.0000	0.0000	0.0000	265.7700	518.4693	750.4717	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

223.4229	196.9428	206.8736	185.5042	181.8285	162.5286	156.1466	171.2651	170.9387	192.3545	203.3250	218.0663	(64)

Efficiency of water heater 170.0000 (216)

(217)m 170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000 (217)

Fuel for water heating, kWh/month

131.4253	115.8487	121.6903	109.1201	106.9579	95.6051	91.8510	100.7442	100.5522	113.1497	119.6030	128.2743 (219)

Water heating fuel used 1334.8217 (219)
Space cooling fuel requirement

(221)m 0.0000	0.0000	0.0000	0.0000	0.0000	55.5699	63.7008	52.0283	0.0000	0.0000	0.0000	0.0000 (221)

Cooling 171.2991 (221)
Annual totals kWh/year
Space heating fuel - main system 3589.7829 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375)
mechanical ventilation fans (SFP = 0.9375) 469.6661 (230a)
central heating pump 30.0000 (230c)
Total electricity for the above, kWh/year 499.6661 (231)
Electricity for lighting (calculated in Appendix L) 513.2403 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.31 * 1080 * 1.00) = -1131.3418 -1131.3418 (233)
Total delivered energy for all uses 4977.4683 (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3589.7829	0.5190	1863.0973	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1334.8217	0.5190	692.7725	(264)
Space and water heating			2555.8698	(265)
Space cooling	171.2991	0.5190	88.9042	(266)
Pumps and fans	499.6661	0.5190	259.3267	(267)
Energy for lighting	513.2403	0.5190	266.3717	(268)
Energy saving/generation technologies				
PV Unit	-1131.3418	0.5190	-587.1664	(269)
Total CO2, kg/year			2583.3060	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.6600	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		16.6600	ZC1
Total Floor Area	TFA	155.0700	
Assumed number of occupants	N	2.9418	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.4571	ZC2
CO2 emissions from cooking, equation (L16)		1.2227	ZC3
Total CO2 emissions		30.3398	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		30.3398	ZC8

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	125.2500 (1b)	x	2.6000 (2b)	=	325.6500 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	155.0700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		410.6370	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.2500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Balanced mechanical ventilation with heat recovery		
If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	54.6000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.4979	0.4926	0.4873	0.4608	0.4554	0.4289	0.4289	0.4236	0.4395	0.4554	0.4661	0.4767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 0.74)			61.0400	0.7187	43.8710			(27)
penthouse floor			125.2500	0.1500	18.7875			(28a)
External Wall 1	67.6600	35.8500	31.8100	0.7400	23.5394			(29a)
External Wall 2	44.9600	25.1900	19.7700	0.7400	14.6298			(29a)
penthouse roof	95.4300		95.4300	0.1000	9.5430			(30)
garden room roof	29.8200		29.8200	0.1000	2.9820			(30)
Total net area of external elements Aum(A, m2)			363.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		113.3527			(33)
Party Wall 1			76.0100	0.0000	0.0000			(32)
Party Wall 2			26.6900	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.6447	(36)
Total fabric heat loss (33) + (36) =	120.9974	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	67.4756	66.7557	66.0358	62.4363	61.7164	58.1169	58.1169	57.3970	59.5567	61.7164	63.1562	64.5960	(38)
Heat transfer coeff	188.4730	187.7531	187.0332	183.4337	182.7138	179.1144	179.1144	178.3945	180.5542	182.7138	184.1536	185.5934	(39)

Average = Sum(39)m / 12 = 183.2538 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2154	1.2108	1.2061	1.1829	1.1783	1.1551	1.1551	1.1504	1.1643	1.1783	1.1876	1.1968	(40)
HLP (average)												1.1817	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9418 (42)
Average daily hot water use (litres/day)	104.0688 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.4756	110.3129	106.1501	101.9874	97.8246	93.6619	93.6619	97.8246	101.9874	106.1501	110.3129	114.4756	(44)
Energy conte	169.7641	148.4767	153.2147	133.5763	128.1696	110.6006	102.4877	117.6062	119.0108	138.6956	151.3971	164.4074	(45)
Energy content (annual)											Total = Sum(45)m =	1637.4068	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4646	22.2715	22.9822	20.0364	19.2254	16.5901	15.3732	17.6409	17.8516	20.8043	22.7096	24.6611	(46)

Water storage loss:		
Store volume	150.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0191	(51)
Volume factor from Table 2a	0.9283	(52)
Temperature factor from Table 2b	0.5400	(53)

Enter (49) or (54) in (55)													1.4364 (55)
Total storage loss													
	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(56)
If cylinder contains dedicated solar storage													
	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	237.5547	209.7069	221.0053	199.1801	195.9602	176.2044	170.2783	185.3968	184.6146	206.4862	217.0009	232.1980	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =					0.0000 (63)
Output from w/h													
	237.5547	209.7069	221.0053	199.1801	195.9602	176.2044	170.2783	185.3968	184.6146	206.4862	217.0009	232.1980	(64)
								Total per year (kWh/year) = Sum(64)m =					2435.5864 (64)
Heat gains from water heating, kWh/month													
	110.6790	98.3527	105.1764	96.8972	96.8489	89.2577	88.3096	93.3365	92.0541	100.3488	102.8226	108.8979	(65)

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	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	29.0618	25.8124	20.9921	15.8924	11.8797	10.0294	10.8371	14.0864	18.9068	24.0065	28.0191	29.8695	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	325.9849	329.3676	320.8433	302.6961	279.7884	258.2585	243.8752	240.4925	249.0168	267.1640	290.0716	311.6016	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	(71)
Water heating gains (Table 5)													
	148.7621	146.3582	141.3661	134.5794	130.1732	123.9691	118.6958	125.4523	127.8529	134.8774	142.8091	146.3682	(72)
Total internal gains													
	573.9364	571.6658	553.3291	523.2954	491.9690	462.3846	443.5357	450.1589	465.9042	496.1755	531.0275	557.9669	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	2.5600	46.7521	0.3600	1.0000	0.7700	29.8591	(78)
West	58.4800	19.6403	0.3600	1.0000	0.7700	286.5434	(80)

Solar gains	316.4025	609.4412	985.4208	1416.7319	1723.3409	1759.6477	1677.0229	1448.2747	1138.7084	717.8724	392.6791	261.4404	(83)
Total gains	890.3389	1181.1070	1538.7499	1940.0273	2215.3099	2222.0323	2120.5586	1898.4335	1604.6126	1214.0479	923.7067	819.4073	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	22.8547	22.9424	23.0307	23.4826	23.5751	24.0489	24.0489	24.1459	23.8571	23.5751	23.3908	23.2093	
alpha	2.5236	2.5295	2.5354	2.5655	2.5717	2.6033	2.6033	2.6097	2.5905	2.5717	2.5594	2.5473	
util living area													
	0.9700	0.9413	0.8811	0.7661	0.6195	0.4668	0.3534	0.4034	0.6254	0.8570	0.9517	0.9753	(86)
MIT	18.4271	18.8437	19.4674	20.1647	20.6270	20.8745	20.9554	20.9368	20.7223	20.0191	19.0885	18.3711	(87)
Th 2	19.9077	19.9114	19.9151	19.9337	19.9374	19.9561	19.9561	19.9599	19.9486	19.9374	19.9300	19.9225	(88)
util rest of house													
	0.9653	0.9325	0.8639	0.7346	0.5717	0.4028	0.2758	0.3215	0.5602	0.8291	0.9429	0.9714	(89)
MIT 2	17.5620	17.9739	18.5818	19.2516	19.6653	19.8821	19.9373	19.9314	19.7685	19.1393	18.2335	17.5168	(90)
Living area fraction										fLA = Living area / (4) =		0.2751	(91)
MIT	17.8000	18.2132	18.8254	19.5028	19.9298	20.1551	20.2174	20.2080	20.0309	19.3813	18.4687	17.7518	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8000	18.2132	18.8254	19.5028	19.9298	20.1551	20.2174	20.2080	20.0309	19.3813	18.4687	17.7518	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9529	0.9148	0.8431	0.7204	0.5714	0.4155	0.2957	0.3417	0.5657	0.8116	0.9272	0.9605	(94)
Useful gains	848.4073	1080.4378	1297.3202	1397.6689	1265.7390	923.1751	627.0941	648.7227	907.7211	985.3518	856.4778	787.0614	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2544.3791	2499.5980	2305.2670	1944.9051	1503.7053	995.0025	647.9291	679.3224	1070.8482	1604.4704	2093.5859	2515.1243	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1261.8030	953.6756	749.9125	394.0100	177.0470	0.0000	0.0000	0.0000	0.0000	460.6243	890.7178	1285.6788	(98)
Space heating												6173.4690	(98)
Space heating per m2											(98) / (4) =	39.8109	(99)

8c. Space cooling requirement

Not applicable

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES			
DER		16.3300	ZC1
Total Floor Area	TFA	155.0700	
Assumed number of occupants	N	2.9418	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.4571	ZC2
CO2 emissions from cooking, equation (L16)		1.2227	ZC3
Total CO2 emissions		30.0098	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5

Additional allowable electricity generation, kWh/m²/year	0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation	0.0000	ZC7
Net CO2 emissions	30.0098	ZC8

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	125.2500 (1b)	x	2.6000 (2b)	=	325.6500 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	155.0700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		410.6370	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0974	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3474	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2953	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3765	0.3691	0.3617	0.3248	0.3174	0.2805	0.2805	0.2732	0.2953	0.3174	0.3322	0.3470	(22b)
Effective ac	0.5709	0.5681	0.5654	0.5528	0.5504	0.5393	0.5393	0.5373	0.5436	0.5504	0.5552	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type Curtain (Uw = 1.50)			38.7600	1.4151	54.8491			(27)
penthouse floor			125.2500	0.1300	16.2825			(28a)
External Wall 1	67.6600	22.7600	44.9000	0.1800	8.0820			(29a)
External Wall 2	44.9600	16.0000	28.9600	0.1800	5.2128			(29a)
penthouse roof	95.4300		95.4300	0.1300	12.4059			(30)
garden room roof	29.8200		29.8200	0.1300	3.8766			(30)
Total net area of external elements Aum(A, m2)			363.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		100.7089			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.5408 (36)
Total fabric heat loss	(33) + (36) =	107.2497 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.3598	76.9868	76.6213	74.9042	74.5829	73.0874	73.0874	72.8104	73.6634	74.5829	75.2328	75.9123	(38)
Heat transfer coeff	184.6095	184.2365	183.8709	182.1538	181.8326	180.3370	180.3370	180.0601	180.9131	181.8326	182.4825	183.1619	(39)
Average = Sum(39)m / 12 =												182.1523	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1905	1.1881	1.1857	1.1747	1.1726	1.1629	1.1629	1.1612	1.1667	1.1726	1.1768	1.1812	(40)
HLP (average)												1.1746	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.9418 (42)
Average daily hot water use (litres/day)		104.0688 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.4756	110.3129	106.1501	101.9874	97.8246	93.6619	93.6619	97.8246	101.9874	106.1501	110.3129	114.4756	(44)
Energy conte	169.7641	148.4767	153.2147	133.5763	128.1696	110.6006	102.4877	117.6062	119.0108	138.6956	151.3971	164.4074	(45)
Energy content (annual)										Total = Sum(45)m =		1637.4068	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4646	22.2715	22.9822	20.0364	19.2254	16.5901	15.3732	17.6409	17.8516	20.8043	22.7096	24.6611	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	219.0067	192.9540	202.4574	181.2305	177.4123	158.2548	151.7304	166.8489	166.6650	187.9383	199.0513	213.6501	(62)

Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	219.0067	192.9540	202.4574	181.2305	177.4123	158.2548	151.7304	166.8489	166.6650	187.9383	199.0513	213.6501	(64)
Total per year (kWh/year) = Sum(64)m =												2217.1996	(64)
Heat gains from water heating, kWh/month	95.8407	84.9503	90.3380	82.5375	82.0105	74.8981	73.4713	78.4982	77.6944	85.5104	88.4629	94.0596	(65)

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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	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	29.0618	25.8124	20.9921	15.8924	11.8797	10.0294	10.8371	14.0864	18.9068	24.0065	28.0191	29.8695	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	325.9849	329.3676	320.8433	302.6961	279.7884	258.2585	243.8752	240.4925	249.0168	267.1640	290.0716	311.6016	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	(71)
Water heating gains (Table 5)													
	128.8181	126.4142	121.4221	114.6354	110.2292	104.0251	98.7518	105.5083	107.9089	114.9334	122.8651	126.4242	(72)
Total internal gains													
	553.9924	551.7218	533.3851	503.3514	472.0250	442.4406	423.5917	430.2149	445.9602	476.2315	511.0835	538.0229	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	1.6200	46.7521	0.6300	0.7000	0.7700	23.1466	(78)
West	37.1400	19.6403	0.6300	0.7000	0.7700	222.9262	(80)

Solar gains	246.0728	473.9991	766.4679	1101.9983	1340.5269	1368.7808	1304.5045	1126.5476	885.7154	558.3461	305.3994	203.3244	(83)
Total gains	800.0652	1025.7209	1299.8529	1605.3498	1812.5519	1811.2214	1728.0962	1556.7625	1331.6755	1034.5776	816.4829	741.3474	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.3326	58.4507	58.5669	59.1190	59.2234	59.7146	59.7146	59.8064	59.5244	59.2234	59.0125	58.7936	
alpha	4.8888	4.8967	4.9045	4.9413	4.9482	4.9810	4.9810	4.9871	4.9683	4.9482	4.9342	4.9196	
util living area													
	0.9990	0.9964	0.9847	0.9331	0.8018	0.6110	0.4540	0.5211	0.8044	0.9764	0.9975	0.9993	(86)
MIT	19.6270	19.8306	20.1659	20.5743	20.8566	20.9712	20.9946	20.9897	20.8931	20.4687	19.9621	19.5930	(87)
Th 2	19.9276	19.9295	19.9314	19.9403	19.9420	19.9498	19.9498	19.9512	19.9468	19.9420	19.9386	19.9351	(88)
util rest of house													
	0.9986	0.9951	0.9792	0.9102	0.7443	0.5216	0.3484	0.4079	0.7246	0.9645	0.9964	0.9991	(89)
MIT 2	18.0908	18.3894	18.8766	19.4548	19.8099	19.9320	19.9479	19.9472	19.8647	19.3229	18.5887	18.0463	(90)
Living area fraction									fLA = Living area / (4) =			0.2751	(91)
MIT	18.5134	18.7859	19.2313	19.7627	20.0978	20.2179	20.2358	20.2340	20.1476	19.6381	18.9665	18.4718	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5134	18.7859	19.2313	19.7627	20.0978	20.2179	20.2358	20.2340	20.1476	19.6381	18.9665	18.4718	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9931	0.9744	0.9056	0.7536	0.5453	0.3775	0.4391	0.7416	0.9599	0.9949	0.9985	(94)
Useful gains	798.3912	1018.6921	1266.5399	1453.8005	1365.8890	987.6132	652.4089	683.6439	987.6115	993.1202	812.3369	740.2685	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2623.9258	2558.2914	2340.9184	1978.6881	1527.0005	1013.1202	655.6780	690.3540	1094.0963	1643.4238	2165.4293	2614.0519	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1358.1977	1034.6107	799.3377	377.9191	119.8670	0.0000	0.0000	0.0000	0.0000	483.8259	974.2266	1394.0949	(98)
Space heating												6542.0795	(98)
Space heating per m2											(98) / (4) =	42.1879	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6996.8765	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1358.1977	1034.6107	799.3377	377.9191	119.8670	0.0000	0.0000	0.0000	0.0000	483.8259	974.2266	1394.0949	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													

	1452.6179	1106.5355	854.9066	404.1915	128.2000	0.0000	0.0000	0.0000	0.0000	517.4608	1041.9535	1491.0106 (211)
Water heating requirement												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement												
	219.0067	192.9540	202.4574	181.2305	177.4123	158.2548	151.7304	166.8489	166.6650	187.9383	199.0513	213.6501 (64)
Efficiency of water heater												79.8000 (216)
(217)m	88.8458	88.6320	88.1123	86.7307	83.7947	79.8000	79.8000	79.8000	79.8000	87.2278	88.4871	88.9157 (217)
Fuel for water heating, kWh/month												
	246.5021	217.7024	229.7719	208.9576	211.7225	198.3143	190.1384	209.0838	208.8534	215.4567	224.9495	240.2840 (219)
Water heating fuel used												2601.7365 (219)
Annual totals kWh/year												
Space heating fuel - main system												6996.8765 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												75.0000 (231)
Electricity for lighting (calculated in Appendix L)												513.2403 (232)
Total delivered energy for all uses												10186.8533 (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6996.8765	0.2160	1511.3253	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2601.7365	0.2160	561.9751	(264)
Space and water heating			2073.3004	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	513.2403	0.5190	266.3717	(268)
Total CO2, kg/m2/year			2378.5971	(272)
Emissions per m2 for space and water heating			13.3701	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.7178	(272b)
Emissions per m2 for pumps and fans			0.2510	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.3701 * 1.55) + 1.7178 + 0.2510, rounded to 2 d.p.			22.6900	(273)

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	125.2500 (1b)	x	2.6000 (2b)	=	325.6500 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	155.0700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	410.6370	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0974	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3474	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2953	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3765	0.3691	0.3617	0.3248	0.3174	0.2805	0.2805	0.2732	0.2953	0.3174	0.3322	0.3470	(22b)
Effective ac	0.5709	0.5681	0.5654	0.5528	0.5504	0.5393	0.5393	0.5373	0.5436	0.5504	0.5552	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 0.74)			61.0400	0.7187	43.8710			(27)
penthouse floor			125.2500	0.1500	18.7875			(28a)
External Wall 1	67.6600	35.8500	31.8100	0.7400	23.5394			(29a)
External Wall 2	44.9600	25.1900	19.7700	0.7400	14.6298			(29a)
penthouse roof	95.4300		95.4300	0.1000	9.5430			(30)
garden room roof	29.8200		29.8200	0.1000	2.9820			(30)
Total net area of external elements Aum(A, m2)			363.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	113.3527			(33)
Party Wall 1			76.0100	0.0000	0.0000			(32)
Party Wall 2			26.6900	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.6447 (36)
Total fabric heat loss	(33) + (36) =	120.9974 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.3598	76.9868	76.6213	74.9042	74.5829	73.0874	73.0874	72.8104	73.6634	74.5829	75.2328	75.9123	(38)
Heat transfer coeff	198.3572	197.9843	197.6187	195.9016	195.5803	194.0848	194.0848	193.8078	194.6608	195.5803	196.2302	196.9097	(39)
Average = Sum(39)m / 12 =												195.9000	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2791	1.2767	1.2744	1.2633	1.2612	1.2516	1.2516	1.2498	1.2553	1.2612	1.2654	1.2698	(40)
HLP (average)												1.2633	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9418 (42)
Average daily hot water use (litres/day)	104.0688 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.4756	110.3129	106.1501	101.9874	97.8246	93.6619	93.6619	97.8246	101.9874	106.1501	110.3129	114.4756	(44)
Energy conte	169.7641	148.4767	153.2147	133.5763	128.1696	110.6006	102.4877	117.6062	119.0108	138.6956	151.3971	164.4074	(45)
Energy content (annual)										Total = Sum(45)m =		1637.4068	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	36.0749	31.5513	32.5581	28.3850	27.2360	23.5026	21.7786	24.9913	25.2898	29.4728	32.1719	34.9366	(65)

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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	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	(66)

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

	29.0618	25.8124	20.9921	15.8924	11.8797	10.0294	10.8371	14.0864	18.9068	24.0065	28.0191	29.8695	(67)

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

	325.9849	329.3676	320.8433	302.6961	279.7884	258.2585	243.8752	240.4925	249.0168	267.1640	290.0716	311.6016	(68)

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

	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

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

	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	(71)

Water heating gains (Table 5)

	48.4877	46.9513	43.7609	39.4236	36.6076	32.6425	29.2724	33.5905	35.1247	39.6140	44.6832	46.9578	(72)

Total internal gains

	470.6620	469.2590	452.7239	425.1396	395.4034	368.0581	351.1123	355.2970	370.1759	397.9122	429.9016	455.5565	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	2.5600	46.7521	0.3600	1.0000	0.7700	29.8591	(78)
West	58.4800	19.6403	0.3600	1.0000	0.7700	286.5434	(80)

Solar gains	316.4025	609.4412	985.4208	1416.7319	1723.3409	1759.6477	1677.0229	1448.2747	1138.7084	717.8724	392.6791	261.4404	(83)
Total gains	787.0645	1078.7002	1438.1448	1841.8715	2118.7442	2127.7058	2028.1352	1803.5717	1508.8843	1115.7846	822.5807	716.9968	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.7159	21.7568	21.7970	21.9881	22.0242	22.1939	22.1939	22.2256	22.1282	22.0242	21.9513	21.8755	
alpha	2.4477	2.4505	2.4531	2.4659	2.4683	2.4796	2.4796	2.4817	2.4752	2.4683	2.4634	2.4584	
util living area													
	0.9772	0.9524	0.8988	0.7946	0.6556	0.5082	0.3910	0.4467	0.6697	0.8829	0.9630	0.9817	(86)
MIT	18.1952	18.6159	19.2628	19.9948	20.5232	20.8210	20.9322	20.9044	20.6303	19.8363	18.8559	18.1192	(87)
Th 2	19.8572	19.8591	19.8610	19.8697	19.8713	19.8789	19.8789	19.8804	19.8760	19.8713	19.8680	19.8646	(88)
util rest of house													
	0.9735	0.9448	0.8831	0.7640	0.6062	0.4373	0.3014	0.3529	0.6019	0.8575	0.9559	0.9786	(89)
MIT 2	17.2991	17.7153	18.3474	19.0474	19.5232	19.7742	19.8510	19.8380	19.6358	18.9212	17.9635	17.2287	(90)
Living area fraction									fLA = Living area / (4) =			0.2751	(91)
MIT	17.5456	17.9630	18.5992	19.3080	19.7983	20.0621	20.1485	20.1314	19.9094	19.1730	18.2090	17.4737	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.5456	17.9630	18.5992	19.3080	19.7983	20.0621	20.1485	20.1314	19.9094	19.1730	18.2090	17.4737	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9628	0.9281	0.8616	0.7467	0.6027	0.4495	0.3238	0.3750	0.6042	0.8382	0.9416	0.9695	(94)
Useful gains	757.7672	1001.1331	1239.0535	1375.2543	1277.0258	956.3900	656.7106	676.3850	911.6325	935.2121	774.5111	695.1051	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2627.3690	2586.2719	2391.0295	2038.9446	1583.8712	1060.1185	688.7003	723.1733	1130.8628	1676.7012	2179.9176	2613.7159	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1390.9838	1065.2132	857.0701	477.8570	228.2929	0.0000	0.0000	0.0000	0.0000	551.6680	1011.8927	1427.4464	(98)
Space heating												7010.4241	(98)
Space heating per m2											(98) / (4) =	45.2081	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1824.3969	1436.2273	1472.9395	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8266	0.8736	0.8418	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1508.0045	1254.6865	1239.9469	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2614.3373	2494.9443	2234.9689	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	796.5596	922.7518	740.2963	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												2459.6077	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	199.1399	230.6879	185.0741	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												614.9019	(107)
Space cooling per m2												3.9653	(108)
Energy for space heating												45.2081	(99)
Energy for space cooling												3.9653	(108)
Total												49.1734	(109)
Dwelling Fabric Energy Efficiency (DFEE)												49.2	(109)

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	125.2500 (1b)	x	2.6000 (2b)	=	325.6500 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	155.0700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		410.6370	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0974 (8)
Pressure test		Yes
Measured/design q50		5.0000
Infiltration rate		0.3474 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2953 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3765	0.3691	0.3617	0.3248	0.3174	0.2805	0.2805	0.2732	0.2953	0.3174	0.3322	0.3470	(22b)
Effective ac	0.5709	0.5681	0.5654	0.5528	0.5504	0.5393	0.5393	0.5373	0.5436	0.5504	0.5552	0.5602	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type Curtain (Uw = 1.50)			38.7600	1.4151	54.8491			(27)
penthouse floor			125.2500	0.1300	16.2825			(28a)
External Wall 1	67.6600	22.7600	44.9000	0.1800	8.0820			(29a)
External Wall 2	44.9600	16.0000	28.9600	0.1800	5.2128			(29a)
penthouse roof	95.4300		95.4300	0.1300	12.4059			(30)
garden room roof	29.8200		29.8200	0.1300	3.8766			(30)
Total net area of external elements Aum(A, m2)			363.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		100.7089			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.5408	(36)
Total fabric heat loss					(33) + (36) =		107.2497	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	77.3598	76.9868	76.6213	74.9042	74.5829	73.0874	73.0874	72.8104	73.6634	74.5829	75.2328	75.9123	(38)
Heat transfer coeff	184.6095	184.2365	183.8709	182.1538	181.8326	180.3370	180.3370	180.0601	180.9131	181.8326	182.4825	183.1619	(39)
Average = Sum(39)m / 12 =												182.1523	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1905	1.1881	1.1857	1.1747	1.1726	1.1629	1.1629	1.1612	1.1667	1.1726	1.1768	1.1812	(40)
HLP (average)												1.1746	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.9418 (42)
Average daily hot water use (litres/day)		104.0688 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.4756	110.3129	106.1501	101.9874	97.8246	93.6619	93.6619	97.8246	101.9874	106.1501	110.3129	114.4756	(44)
Energy conte	169.7641	148.4767	153.2147	133.5763	128.1696	110.6006	102.4877	117.6062	119.0108	138.6956	151.3971	164.4074	(45)
Energy content (annual)										Total = Sum(45)m =		1637.4068	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	36.0749	31.5513	32.5581	28.3850	27.2360	23.5026	21.7786	24.9913	25.2898	29.4728	32.1719	34.9366	(65)

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	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	147.0921	(66)

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

	29.0618	25.8124	20.9921	15.8924	11.8797	10.0294	10.8371	14.0864	18.9068	24.0065	28.0191	29.8695	(67)

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

	325.9849	329.3676	320.8433	302.6961	279.7884	258.2585	243.8752	240.4925	249.0168	267.1640	290.0716	311.6016	(68)

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

	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	37.7092	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

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

	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	(71)

Water heating gains (Table 5)

	48.4877	46.9513	43.7609	39.4236	36.6076	32.6425	29.2724	33.5905	35.1247	39.6140	44.6832	46.9578	(72)

Total internal gains

	470.6620	469.2590	452.7239	425.1396	395.4034	368.0581	351.1123	355.2970	370.1759	397.9122	429.9016	455.5565	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	1.6200	46.7521	0.6300	0.7000	0.7700	23.1466	(78)
West	37.1400	19.6403	0.6300	0.7000	0.7700	222.9262	(80)

Solar gains	246.0728	473.9991	766.4679	1101.9983	1340.5269	1368.7808	1304.5045	1126.5476	885.7154	558.3461	305.3994	203.3244	(83)
Total gains	716.7348	943.2581	1219.1918	1527.1379	1735.9303	1736.8388	1655.6168	1481.8446	1255.8913	956.2583	735.3010	658.8809	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.3326	58.4507	58.5669	59.1190	59.2234	59.7146	59.7146	59.8064	59.5244	59.2234	59.0125	58.7936	
alpha	4.8888	4.8967	4.9045	4.9413	4.9482	4.9810	4.9810	4.9871	4.9683	4.9482	4.9342	4.9196	
util living area	0.9994	0.9975	0.9882	0.9435	0.8208	0.6326	0.4728	0.5450	0.8299	0.9828	0.9984	0.9996	(86)
MIT	19.5771	19.7819	20.1207	20.5398	20.8394	20.9665	20.9935	20.9875	20.8756	20.4262	19.9137	19.5435	(87)
Th 2	19.9276	19.9295	19.9314	19.9403	19.9420	19.9498	19.9498	19.9512	19.9468	19.9420	19.9386	19.9351	(88)
util rest of house	0.9992	0.9966	0.9839	0.9233	0.7655	0.5419	0.3633	0.4278	0.7539	0.9737	0.9977	0.9995	(89)
MIT 2	18.6237	18.8295	19.1672	19.5780	19.8396	19.9355	19.9482	19.9479	19.8798	19.4790	18.9688	18.5960	(90)
Living area fraction										fLA = Living area / (4) =		0.2751	(91)
MIT	18.8860	19.0915	19.4295	19.8426	20.1146	20.2191	20.2358	20.2339	20.1537	19.7396	19.2287	18.8567	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8860	19.0915	19.4295	19.8426	20.1146	20.2191	20.2358	20.2339	20.1537	19.7396	19.2287	18.8567	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9989	0.9956	0.9812	0.9211	0.7754	0.5661	0.3936	0.4603	0.7708	0.9714	0.9971	0.9992	(94)
Useful gains	715.9204	939.1539	1196.2911	1406.6141	1346.0581	983.3095	651.7260	682.0692	968.0666	928.8813	733.1611	658.3851	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2692.7109	2614.5924	2377.3565	1993.2307	1530.0530	1013.3370	655.6677	690.3250	1095.2017	1661.8769	2213.2808	2684.5490	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1470.7321	1125.8946	878.7126	422.3639	136.8922	0.0000	0.0000	0.0000	0.0000	545.3488	1065.6861	1507.4660	(98)
Space heating												7153.0964	(98)
Space heating per m2											(98) / (4) =	46.1282	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1695.1679	1334.4939	1368.4565	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9156	0.9562	0.9318	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1552.0679	1276.0263	1275.1844	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2157.4798	2059.5331	1858.9243	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	435.8966	582.9291	434.3025	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1453.1282	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	108.9741	145.7323	108.5756	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												363.2820	(107)
Space cooling per m2												2.3427	(108)
Energy for space heating												46.1282	(99)
Energy for space cooling												2.3427	(108)
Total												48.4709	(109)
Target Fabric Energy Efficiency (TFEE)												55.7	(109)

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	125.2500 (1b)	x	2.6000 (2b)	=	325.6500 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	155.0700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		410.6370	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.2500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2231	0.2125	0.2125	0.1966	0.1966	0.1753	0.1806	0.1700	0.1753	0.1859	0.1859	0.2019	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	54.6000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.4501	0.4395	0.4395	0.4236	0.4236	0.4023	0.4076	0.3970	0.4023	0.4129	0.4129	0.4289	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 0.74)			61.0400	0.7187	43.8710			(27)
penthouse floor			125.2500	0.1500	18.7875			(28a)
External Wall 1	67.6600	35.8500	31.8100	0.7400	23.5394			(29a)
External Wall 2	44.9600	25.1900	19.7700	0.7400	14.6298			(29a)
penthouse roof	95.4300		95.4300	0.1000	9.5430			(30)
garden room roof	29.8200		29.8200	0.1000	2.9820			(30)
Total net area of external elements Aum(A, m2)			363.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		113.3527			(33)
Party Wall 1			76.0100	0.0000	0.0000			(32)
Party Wall 2			26.6900	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.6447	(36)
Total fabric heat loss (33) + (36) =	120.9974	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	60.9965	59.5567	59.5567	57.3970	57.3970	54.5175	55.2373	53.7976	54.5175	55.9572	55.9572	58.1169	(38)
Heat transfer coeff	181.9940	180.5542	180.5542	178.3945	178.3945	175.5149	176.2348	174.7950	175.5149	176.9547	176.9547	179.1144	(39)

Average = Sum(39)m / 12 = 177.9145 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1736	1.1643	1.1643	1.1504	1.1504	1.1318	1.1365	1.1272	1.1318	1.1411	1.1411	1.1551	(40)
HLP (average)												1.1473	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9418 (42)
Average daily hot water use (litres/day)	104.0688 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.4756	110.3129	106.1501	101.9874	97.8246	93.6619	93.6619	97.8246	101.9874	106.1501	110.3129	114.4756	(44)
Energy conte	169.7641	148.4767	153.2147	133.5763	128.1696	110.6006	102.4877	117.6062	119.0108	138.6956	151.3971	164.4074	(45)
Energy content (annual)											Total = Sum(45)m =	1637.4068	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4646	22.2715	22.9822	20.0364	19.2254	16.5901	15.3732	17.6409	17.8516	20.8043	22.7096	24.6611	(46)

Water storage loss:		
Store volume	180.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115	(51)
Volume factor from Table 2a	0.8736	(52)
Temperature factor from Table 2b	0.5400	(53)

Enter (49) or (54) in (55) 0.9805 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	30.3965	27.4549	30.3965	29.4160	30.3965	29.4160	30.3965	30.3965	29.4160	30.3965	29.4160	30.3965	(56)
If cylinder contains dedicated solar storage	30.3965	27.4549	30.3965	29.4160	30.3965	29.4160	30.3965	30.3965	29.4160	30.3965	29.4160	30.3965	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	223.4229	196.9428	206.8736	185.5042	181.8285	162.5286	156.1466	171.2651	170.9387	192.3545	203.3250	218.0663	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Output from w/h	223.4229	196.9428	206.8736	185.5042	181.8285	162.5286	156.1466	171.2651	170.9387	192.3545	203.3250	218.0663	(64)

Total per year (kWh/year) = Sum(64)m = 2269.1969 (64)

RHI water heating demand 2269 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	99.3737	88.1414	93.8710	85.9565	85.5435	78.3171	77.0043	82.0312	81.1134	89.0434	91.8819	97.5926	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	72.6545	64.5311	52.4802	39.7309	29.6993	25.0734	27.0927	35.2161	47.2670	60.0163	70.0479	74.6738	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	486.5446	491.5934	478.8706	451.7852	417.5947	385.4605	363.9928	358.9440	371.6668	398.7523	432.9427	465.0770	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.5929	55.5929	55.5929	55.5929	55.5929	55.5929	55.5929	55.5929	55.5929	55.5929	55.5929	55.5929	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	(71)
Water heating gains (Table 5)	133.5667	131.1628	126.1707	119.3840	114.9778	108.7737	103.5004	110.2569	112.6576	119.6820	127.6137	131.1728	(72)
Total internal gains	810.1956	804.7170	774.9512	728.3298	679.7016	636.7373	612.0156	621.8468	649.0211	695.8803	748.0341	788.3533	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	2.5600	50.9848	0.3600	1.0000	0.7700	32.5624	(78)
West	58.4800	22.3313	0.3600	1.0000	0.7700	325.8047	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	358.3672	621.1600	991.0624	1465.4816	1734.2847	1894.1422	1786.0425	1578.9527	1240.4269	781.0116	455.6846	293.2159	(83)
Total gains	1168.5627	1425.8770	1766.0136	2193.8114	2413.9862	2530.8795	2398.0581	2200.7995	1889.4481	1476.8919	1203.7187	1081.5692	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	23.6684	23.8571	23.8571	24.1459	24.1459	24.5421	24.4418	24.6432	24.5421	24.3424	24.3424	24.0489	
alpha	2.5779	2.5905	2.5905	2.6097	2.6097	2.6361	2.6295	2.6429	2.6361	2.6228	2.6228	2.6033	
util living area	0.9401	0.9050	0.8277	0.6850	0.5191	0.3326	0.2242	0.2490	0.4844	0.7655	0.9036	0.9485	(86)
MIT	19.3575	19.6153	20.0420	20.4848	20.7468	20.8670	20.8905	20.8887	20.8089	20.4359	19.8466	19.3254	(87)
Th 2	19.9412	19.9486	19.9486	19.9599	19.9599	19.9749	19.9711	19.9787	19.9749	19.9674	19.9674	19.9561	(88)
util rest of house	0.9311	0.8916	0.8044	0.6471	0.4659	0.2689	0.1513	0.1716	0.4130	0.7249	0.8874	0.9407	(89)
MIT 2	17.7642	18.1355	18.7327	19.3350	19.6614	19.8041	19.8190	19.8261	19.7524	19.2971	18.4853	17.7289	(90)

Living area fraction fLA = Living area / (4) = 0.2751 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	18.2025	18.5426	19.0929	19.6513	19.9600	20.0965	20.1137	20.1184	20.0430	19.6104	18.8598	18.1681	(92)

Temperature adjustment 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	18.2025	18.5426	19.0929	19.6513	19.9600	20.0965	20.1137	20.1184	20.0430	19.6104	18.8598	18.1681	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9120	0.8694	0.7824	0.6349	0.4659	0.2766	0.1615	0.1824	0.4180	0.7089	0.8658	0.9232	(94)
Useful gains	1065.7865	1239.6934	1381.7920	1392.9563	1124.6528	700.1543	387.3773	401.4673	789.7864	1047.0397	1042.1989	998.4513	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2384.5711	2336.8328	2111.2009	1739.5741	1241.6225	719.0051	390.1379	405.2529	850.0242	1417.4725	1921.6853	2340.6901	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	981.1757	737.2777	542.6802	249.5648	87.0255	0.0000	0.0000	0.0000	0.0000	275.6020	633.2302	998.6257	(98)

Space heating 4505.1818 (98)

RHI space heating demand 4505 (98)

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	125.2500 (1b)	x	2.6000 (2b)	=	325.6500 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	155.0700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		410.6370	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.2500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	54.6000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.4979	0.4926	0.4873	0.4608	0.4554	0.4289	0.4289	0.4236	0.4395	0.4554	0.4661	0.4767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 0.74)			61.0400	0.7187	43.8710			(27)
penthouse floor			125.2500	0.1500	18.7875			(28a)
External Wall 1	67.6600	35.8500	31.8100	0.7400	23.5394			(29a)
External Wall 2	44.9600	25.1900	19.7700	0.7400	14.6298			(29a)
penthouse roof	95.4300		95.4300	0.1000	9.5430			(30)
garden room roof	29.8200		29.8200	0.1000	2.9820			(30)
Total net area of external elements Aum(A, m2)			363.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		113.3527			(33)
Party Wall 1			76.0100	0.0000	0.0000			(32)
Party Wall 2			26.6900	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.6447	(36)
Total fabric heat loss (33) + (36) =	120.9974	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	67.4756	66.7557	66.0358	62.4363	61.7164	58.1169	58.1169	57.3970	59.5567	61.7164	63.1562	64.5960	(38)
Heat transfer coeff	188.4730	187.7531	187.0332	183.4337	182.7138	179.1144	179.1144	178.3945	180.5542	182.7138	184.1536	185.5934	(39)

Average = Sum(39)m / 12 = 183.2538 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2154	1.2108	1.2061	1.1829	1.1783	1.1551	1.1551	1.1504	1.1643	1.1783	1.1876	1.1968	(40)
HLP (average)												1.1817	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9418 (42)
Average daily hot water use (litres/day)	104.0688 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.4756	110.3129	106.1501	101.9874	97.8246	93.6619	93.6619	97.8246	101.9874	106.1501	110.3129	114.4756	(44)
Energy conte	169.7641	148.4767	153.2147	133.5763	128.1696	110.6006	102.4877	117.6062	119.0108	138.6956	151.3971	164.4074	(45)
Energy content (annual)											Total = Sum(45)m =	1637.4068	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4646	22.2715	22.9822	20.0364	19.2254	16.5901	15.3732	17.6409	17.8516	20.8043	22.7096	24.6611	(46)

Water storage loss:		
Store volume	180.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115	(51)
Volume factor from Table 2a	0.8736	(52)
Temperature factor from Table 2b	0.5400	(53)

Enter (49) or (54) in (55) 0.9805 (55)
Total storage loss
30.3965 27.4549 30.3965 29.4160 30.3965 29.4160 30.3965 30.3965 29.4160 30.3965 29.4160 30.3965 (56)
If cylinder contains dedicated solar storage
30.3965 27.4549 30.3965 29.4160 30.3965 29.4160 30.3965 30.3965 29.4160 30.3965 29.4160 30.3965 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
223.4229 196.9428 206.8736 185.5042 181.8285 162.5286 156.1466 171.2651 170.9387 192.3545 203.3250 218.0663 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
223.4229 196.9428 206.8736 185.5042 181.8285 162.5286 156.1466 171.2651 170.9387 192.3545 203.3250 218.0663 (64)
Total per year (kWh/year) = Sum(64)m = 2269.1969 (64)
Heat gains from water heating, kWh/month
99.3737 88.1414 93.8710 85.9565 85.5435 78.3171 77.0043 82.0312 81.1134 89.0434 91.8819 97.5926 (65)

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	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
72.6545 64.5311 52.4802 39.7309 29.6993 25.0734 27.0927 35.2161 47.2670 60.0163 70.0479 74.6738 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
486.5446 491.5934 478.8706 451.7852 417.5947 385.4605 363.9928 358.9440 371.6668 398.7523 432.9427 465.0770 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
55.5929 55.5929 55.5929 55.5929 55.5929 55.5929 55.5929 55.5929 55.5929 55.5929 55.5929 55.5929 (69)
Pumps, fans 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
-117.6737 -117.6737 -117.6737 -117.6737 -117.6737 -117.6737 -117.6737 -117.6737 -117.6737 -117.6737 -117.6737 -117.6737 (71)
Water heating gains (Table 5)
133.5667 131.1628 126.1707 119.3840 114.9778 108.7737 103.5004 110.2569 112.6576 119.6820 127.6137 131.1728 (72)
Total internal gains
810.1956 804.7170 774.9512 728.3298 679.7016 636.7373 612.0156 621.8468 649.0211 695.8803 748.0341 788.3533 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	2.5600	46.7521	0.3600	1.0000	0.7700	29.8591	(78)
West	58.4800	19.6403	0.3600	1.0000	0.7700	286.5434	(80)

Solar gains	316.4025	609.4412	985.4208	1416.7319	1723.3409	1759.6477	1677.0229	1448.2747	1138.7084	717.8724	392.6791	261.4404	(83)
Total gains	1126.5981	1414.1582	1760.3720	2145.0617	2403.0424	2396.3851	2289.0385	2070.1215	1787.7295	1413.7527	1140.7132	1049.7937	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	22.8547	22.9424	23.0307	23.4826	23.5751	24.0489	24.0489	24.1459	23.8571	23.5751	23.3908	23.2093	
alpha	2.5236	2.5295	2.5354	2.5655	2.5717	2.6033	2.6033	2.6097	2.5905	2.5717	2.5594	2.5473	
util living area	0.9506	0.9164	0.8502	0.7317	0.5875	0.4390	0.3299	0.3742	0.5828	0.8165	0.9258	0.9577	(86)
MIT	19.1393	19.4326	19.8642	20.3402	20.6497	20.8156	20.8686	20.8576	20.7212	20.2575	19.6127	19.0985	(87)
Th 2	19.9077	19.9114	19.9151	19.9337	19.9374	19.9561	19.9561	19.9599	19.9486	19.9374	19.9300	19.9225	(88)
util rest of house	0.9433	0.9046	0.8299	0.6983	0.5398	0.3773	0.2566	0.2969	0.5179	0.7839	0.9133	0.9513	(89)
MIT 2	17.4270	17.8484	18.4591	19.1225	19.5241	19.7356	19.7879	19.7835	19.6331	19.0355	18.1264	17.3782	(90)
Living area fraction									fLA = Living area / (4) =			0.2751	(91)
MIT	17.8981	18.2842	18.8457	19.4575	19.8338	20.0328	20.0852	20.0790	19.9324	19.3717	18.5353	17.8515	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8981	18.2842	18.8457	19.4575	19.8338	20.0328	20.0852	20.0790	19.9324	19.3717	18.5353	17.8515	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9255	0.8824	0.8064	0.6819	0.5349	0.3820	0.2659	0.3061	0.5168	0.7636	0.8924	0.9351	(94)
Useful gains	1042.6292	1247.8711	1419.4881	1462.6281	1285.2675	915.5163	608.6860	633.5886	923.8952	1079.4750	1018.0033	981.6286	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2562.8726	2512.9319	2309.0504	1936.5986	1486.1573	973.0840	624.2492	656.3121	1053.0709	1602.7042	2105.8439	2533.6255	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1131.0611	850.1209	661.8343	341.2587	149.4620	0.0000	0.0000	0.0000	0.0000	389.2825	783.2453	1154.6857	(98)
Space heating												5460.9506	(98)
Space heating per m2											(98) / (4) =	35.2160	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1683.6750	1325.4463	1355.7979	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8645	0.9048	0.8797	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1455.5814	1199.2625	1192.7464	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2690.4684	2569.1723	2311.6354	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	889.1187	1019.2128	832.4534	0.0000	0.0000	0.0000	0.0000	(104)

Space cooling													2740.7850 (104)
Cooled fraction											fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000		0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	222.2797	254.8032	208.1134	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling													685.1962 (107)
Space cooling per m2													4.4186 (108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	170.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3212.3239 (211)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.0000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1131.0611	850.1209	661.8343	341.2587	149.4620	0.0000	0.0000	0.0000	0.0000	389.2825	783.2453	1154.6857 (98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000 (210)
Space heating fuel (main heating system)	665.3301	500.0711	389.3143	200.7404	87.9188	0.0000	0.0000	0.0000	0.0000	228.9897	460.7325	679.2269 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)

Water heating

Water heating requirement	223.4229	196.9428	206.8736	185.5042	181.8285	162.5286	156.1466	171.2651	170.9387	192.3545	203.3250	218.0663 (64)	
Efficiency of water heater													170.0000 (216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000 (217)	
Fuel for water heating, kWh/month	131.4253	115.8487	121.6903	109.1201	106.9579	95.6051	91.8510	100.7442	100.5522	113.1497	119.6030	128.2743 (219)	
Water heating fuel used													1334.8217 (219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	55.5699	63.7008	52.0283	0.0000	0.0000	0.0000	0.0000 (221)	
Cooling													171.2991 (221)

Annual totals kWh/year		
Space heating fuel - main system		3212.3239 (211)
Space heating fuel - secondary		0.0000 (215)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375)		
mechanical ventilation fans (SFP = 0.9375)		469.6661 (230a)
central heating pump		30.0000 (230c)
Total electricity for the above, kWh/year		499.6661 (231)
Electricity for lighting (calculated in Appendix L)		513.2403 (232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.31 * 1080 * 1.00) =	-1131.3418	-1131.3418 (233)
Total delivered energy for all uses		4600.0092 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3212.3239	13.1900	423.7055 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1334.8217	13.1900	176.0630 (247)
Space cooling	171.2991	13.1900	22.5943 (248)
Mechanical ventilation fans	469.6661	13.1900	61.9490 (249)
Pumps and fans for heating	30.0000	13.1900	3.9570 (249)
Energy for lighting	513.2403	13.1900	67.6964 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit	-1131.3418	13.1900	-149.2240 (252)
Total energy cost			606.7412 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.2737 (257)
SAP value		82.2317
SAP rating (Section 12)		82 (258)
SAP band		B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3212.3239	0.5190	1667.1961 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1334.8217	0.5190	692.7725 (264)
Space and water heating			2359.9686 (265)
Space cooling	171.2991	0.5190	88.9042 (266)
Pumps and fans	499.6661	0.5190	259.3267 (267)
Energy for lighting	513.2403	0.5190	266.3717 (268)
Energy saving/generation technologies			
PV Unit	-1131.3418	0.5190	-587.1664 (269)
Total kg/year			2387.4048 (272)
CO2 emissions per m2			15.4000 (273)
EI value			84.0100
EI rating			84 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.25) / 1.7000 = 8.321, stars = 2
Main heating environmental impact	0.519 × (1 + 0.29 × 0.25) / 1.7000 = 0.3274, stars = 4
Water heating energy efficiency	13.19 / 1.7000 = 7.759, stars = 2
Water heating environmental impact	0.519 / 1.7000 = 0.3053, stars = 4

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	125.2500 (1b)	x	2.6000 (2b)	=	325.6500 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	155.0700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		410.6370	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.2500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2231	0.2125	0.2125	0.1966	0.1966	0.1753	0.1806	0.1700	0.1753	0.1859	0.1859	0.2019	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	54.6000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.4501	0.4395	0.4395	0.4236	0.4236	0.4023	0.4076	0.3970	0.4023	0.4129	0.4129	0.4289	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 0.74)			61.0400	0.7187	43.8710			(27)
penthouse floor			125.2500	0.1500	18.7875			(28a)
External Wall 1	67.6600	35.8500	31.8100	0.7400	23.5394			(29a)
External Wall 2	44.9600	25.1900	19.7700	0.7400	14.6298			(29a)
penthouse roof	95.4300		95.4300	0.1000	9.5430			(30)
garden room roof	29.8200		29.8200	0.1000	2.9820			(30)
Total net area of external elements Aum(A, m2)			363.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		113.3527			(33)
Party Wall 1			76.0100	0.0000	0.0000			(32)
Party Wall 2			26.6900	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.6447	(36)
Total fabric heat loss (33) + (36) =	120.9974	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	60.9965	59.5567	59.5567	57.3970	57.3970	54.5175	55.2373	53.7976	54.5175	55.9572	55.9572	58.1169	(38)
Heat transfer coeff	181.9940	180.5542	180.5542	178.3945	178.3945	175.5149	176.2348	174.7950	175.5149	176.9547	176.9547	179.1144	(39)

Average = Sum(39)m / 12 = 177.9145 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1736	1.1643	1.1643	1.1504	1.1504	1.1318	1.1365	1.1272	1.1318	1.1411	1.1411	1.1551	(40)
HLP (average)												1.1473	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9418 (42)
Average daily hot water use (litres/day)	104.0688 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.4756	110.3129	106.1501	101.9874	97.8246	93.6619	93.6619	97.8246	101.9874	106.1501	110.3129	114.4756	(44)
Energy conte	169.7641	148.4767	153.2147	133.5763	128.1696	110.6006	102.4877	117.6062	119.0108	138.6956	151.3971	164.4074	(45)
Energy content (annual)											Total = Sum(45)m =	1637.4068	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4646	22.2715	22.9822	20.0364	19.2254	16.5901	15.3732	17.6409	17.8516	20.8043	22.7096	24.6611	(46)

Water storage loss:		
Store volume	180.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115	(51)
Volume factor from Table 2a	0.8736	(52)
Temperature factor from Table 2b	0.5400	(53)

Enter (49) or (54) in (55) 0.9805 (55)
Total storage loss
30.3965 27.4549 30.3965 29.4160 30.3965 29.4160 30.3965 30.3965 29.4160 30.3965 29.4160 30.3965 (56)
If cylinder contains dedicated solar storage
30.3965 27.4549 30.3965 29.4160 30.3965 29.4160 30.3965 30.3965 29.4160 30.3965 29.4160 30.3965 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
223.4229 196.9428 206.8736 185.5042 181.8285 162.5286 156.1466 171.2651 170.9387 192.3545 203.3250 218.0663 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
223.4229 196.9428 206.8736 185.5042 181.8285 162.5286 156.1466 171.2651 170.9387 192.3545 203.3250 218.0663 (64)
Total per year (kWh/year) = Sum(64)m = 2269.1969 (64)
Heat gains from water heating, kWh/month
99.3737 88.1414 93.8710 85.9565 85.5435 78.3171 77.0043 82.0312 81.1134 89.0434 91.8819 97.5926 (65)

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	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	176.5106	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	72.6545	64.5311	52.4802	39.7309	29.6993	25.0734	27.0927	35.2161	47.2670	60.0163	70.0479	74.6738	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	486.5446	491.5934	478.8706	451.7852	417.5947	385.4605	363.9928	358.9440	371.6668	398.7523	432.9427	465.0770	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5929	55.5929	55.5929	55.5929	55.5929	55.5929	55.5929	55.5929	55.5929	55.5929	55.5929	55.5929	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	-117.6737	(71)
Water heating gains (Table 5)													
	133.5667	131.1628	126.1707	119.3840	114.9778	108.7737	103.5004	110.2569	112.6576	119.6820	127.6137	131.1728	(72)
Total internal gains													
	810.1956	804.7170	774.9512	728.3298	679.7016	636.7373	612.0156	621.8468	649.0211	695.8803	748.0341	788.3533	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	2.5600	50.9848	0.3600	1.0000	0.7700	32.5624	(78)
West	58.4800	22.3313	0.3600	1.0000	0.7700	325.8047	(80)

Solar gains	358.3672	621.1600	991.0624	1465.4816	1734.2847	1894.1422	1786.0425	1578.9527	1240.4269	781.0116	455.6846	293.2159	(83)
Total gains	1168.5627	1425.8770	1766.0136	2193.8114	2413.9862	2530.8795	2398.0581	2200.7995	1889.4481	1476.8919	1203.7187	1081.5692	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	23.6684	23.8571	23.8571	24.1459	24.1459	24.5421	24.4418	24.6432	24.5421	24.3424	24.3424	24.0489	
alpha	2.5779	2.5905	2.5905	2.6097	2.6097	2.6361	2.6295	2.6429	2.6361	2.6228	2.6228	2.6033	
util living area													
	0.9401	0.9050	0.8277	0.6850	0.5191	0.3326	0.2242	0.2490	0.4844	0.7655	0.9036	0.9485	(86)
MIT	19.3575	19.6153	20.0420	20.4848	20.7468	20.8670	20.8905	20.8887	20.8089	20.4359	19.8466	19.3254	(87)
Th 2	19.9412	19.9486	19.9486	19.9599	19.9599	19.9749	19.9711	19.9787	19.9749	19.9674	19.9674	19.9561	(88)
util rest of house													
	0.9311	0.8916	0.8044	0.6471	0.4659	0.2689	0.1513	0.1716	0.4130	0.7249	0.8874	0.9407	(89)
MIT 2	17.7642	18.1355	18.7327	19.3350	19.6614	19.8041	19.8190	19.8261	19.7524	19.2971	18.4853	17.7289	(90)
Living area fraction									fLA = Living area / (4) =			0.2751	(91)
MIT	18.2025	18.5426	19.0929	19.6513	19.9600	20.0965	20.1137	20.1184	20.0430	19.6104	18.8598	18.1681	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2025	18.5426	19.0929	19.6513	19.9600	20.0965	20.1137	20.1184	20.0430	19.6104	18.8598	18.1681	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9120	0.8694	0.7824	0.6349	0.4659	0.2766	0.1615	0.1824	0.4180	0.7089	0.8658	0.9232	(94)
Useful gains	1065.7865	1239.6934	1381.7920	1392.9563	1124.6528	700.1543	387.3773	401.4673	789.7864	1047.0397	1042.1989	998.4513	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	2384.5711	2336.8328	2111.2009	1739.5741	1241.6225	719.0051	390.1379	405.2529	850.0242	1417.4725	1921.6853	2340.6901	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	981.1757	737.2777	542.6802	249.5648	87.0255	0.0000	0.0000	0.0000	0.0000	275.6020	633.2302	998.6257	(98)
Space heating												4505.1818	(98)
Space heating per m2											(98) / (4) =	29.0526	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1404.1190	1075.0321	1083.7288	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9149	0.9445	0.9327	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1284.6193	1015.3212	1010.8336	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2847.6697	2696.5977	2464.3759	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	1125.3963	1250.8698	1081.4354	0.0000	0.0000	0.0000	0.0000	(104)

Space cooling 3457.7016 (104)
Cooled fraction fC = cooled area / (4) = 1.0000 (105)
Intermittency factor (Table 10b)

0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	281.3491	312.7174	270.3589	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling 864.4254 (107)
Space cooling per m2 5.5744 (108)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 170.0000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2650.1070 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.0000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	981.1757	737.2777	542.6802	249.5648	87.0255	0.0000	0.0000	0.0000	0.0000	275.6020	633.2302	998.6257	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	577.1622	433.6928	319.2237	146.8028	51.1914	0.0000	0.0000	0.0000	0.0000	162.1188	372.4883	587.4269	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

223.4229	196.9428	206.8736	185.5042	181.8285	162.5286	156.1466	171.2651	170.9387	192.3545	203.3250	218.0663	(64)

Efficiency of water heater 170.0000 (216)

(217)m 170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000 (217)

Fuel for water heating, kWh/month

131.4253	115.8487	121.6903	109.1201	106.9579	95.6051	91.8510	100.7442	100.5522	113.1497	119.6030	128.2743 (219)

Water heating fuel used 1334.8217 (219)
Space cooling fuel requirement

(221)m 0.0000	0.0000	0.0000	0.0000	0.0000	70.3373	78.1794	67.5897	0.0000	0.0000	0.0000	0.0000 (221)

Cooling 216.1063 (221)
Annual totals kWh/year
Space heating fuel - main system 2650.1070 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375)
mechanical ventilation fans (SFP = 0.9375) 469.6661 (230a)
central heating pump 30.0000 (230c)
Total electricity for the above, kWh/year 499.6661 (231)
Electricity for lighting (calculated in Appendix L) 513.2403 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.31 * 1140 * 1.00) = -1194.8246 -1194.8246 (233)
Total delivered energy for all uses 4019.1168 (238)

10a. Fuel costs - using BEDF prices (401)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2650.1070	15.4400	409.1765	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1334.8217	15.4400	206.0965	(247)
Space cooling	216.1063	15.4400	33.3668	(248)
Mechanical ventilation fans	469.6661	15.4400	72.5164	(249)
Pumps and fans for heating	30.0000	15.4400	4.6320	(249)
Energy for lighting	513.2403	15.4400	79.2443	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1194.8246	15.4400	-184.4809	(252)
Total energy cost			620.5516	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2650.1070	0.5190	1375.4055	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1334.8217	0.5190	692.7725	(264)
Space and water heating			2068.1780	(265)
Space cooling	216.1063	0.5190	112.1592	(266)
Pumps and fans	499.6661	0.5190	259.3267	(267)
Energy for lighting	513.2403	0.5190	266.3717	(268)
Energy saving/generation technologies				
PV Unit	-1194.8246	0.5190	-620.1139	(269)
Total kg/year			2085.9216	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2650.1070	3.0700	8135.8283	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1334.8217	3.0700	4097.9026	(264)
Space and water heating			12233.7310	(265)
Space cooling	216.1063	3.0700	663.4465	(266)
Pumps and fans	499.6661	3.0700	1533.9748	(267)
Energy for lighting	513.2403	3.0700	1575.6477	(268)

Energy saving/generation technologies

PV Unit	-1194.8246	3.0700	-3668.1114 (269)
Primary energy kWh/year			12338.6886 (272)
Primary energy kWh/m2/year			79.5685 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 82
Current environmental impact rating: B 84

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Not applicable
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Not applicable
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures: SAP change Cost change CO2 change
(none)

Recommended measures	Typical annual savings		Energy efficiency	Environmental impact
(none)				
Total Savings	£0	0.00 kg/m²		

Potential energy efficiency rating: B 82
Potential environmental impact rating: B 84

Fuel prices for cost data on this page from database revision number 401 TEST (27 Oct 2016)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£805	£805	£0
Space heating	£486	£486	£0
Space cooling	£33	£33	£0
Water heating	£206	£206	£0
Lighting	£79	£79	£0
Generated (PV)	-£184	-£184	£0
Total cost of fuels	£621	£621	£0
Total cost of uses	£620	£620	£0
Delivered energy	26 kWh/m²	26 kWh/m²	0 kWh/m²
Carbon dioxide emissions	2.1 tonnes	2.1 tonnes	0.0 tonnes
CO2 emissions per m²	13 kg/m²	13 kg/m²	0 kg/m²
Primary energy	80 kWh/m²	80 kWh/m²	0 kWh/m²

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	EndTerrace Flat
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	No
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	1084.08 (P1)
Transmission heat loss coefficient	121.00 (37)
Summer heat loss coefficient	1205.08 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
South	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South	2.5600	112.2060	0.3600	1.0000	0.9000	83.7613
West	58.4800	117.5071	0.3600	1.0000	0.9000	2003.8208
total:						2087.5821

	Jun	Jul	Aug	
Solar gains	2214	2088	1846	(P3)
Internal gains	634	609	619	
Total summer gains	2848	2697	2464	(P5)
Summer gain/loss ratio	2.36	2.24	2.04	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	19.66	21.44	21.14	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

Predicted Energy Assessment

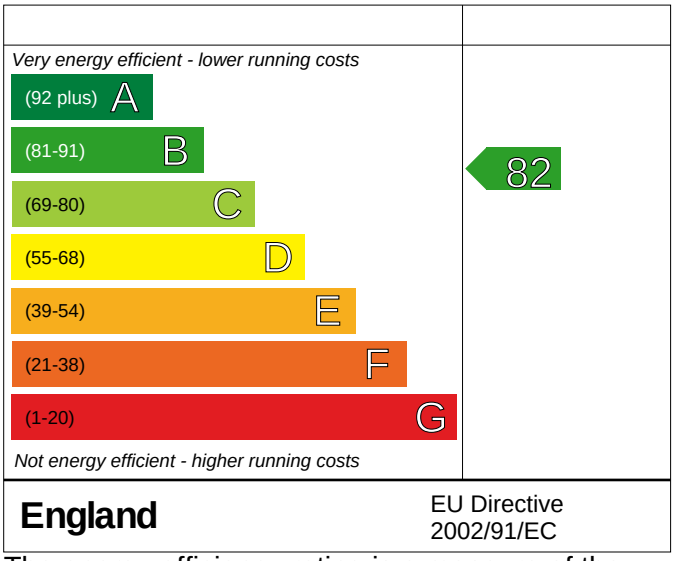
502,
London

Dwelling type:	Flat, End-Terrace
Date of assessment:	01.Nov.2016
Produced by:	Gecko
Total floor area:	155.07 m^2

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

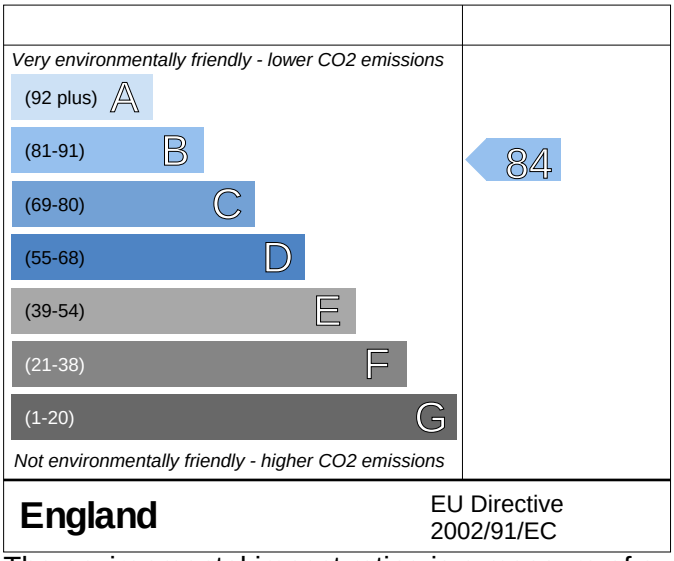
The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO2) Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

SURVEY NOTES

Property Reference: 502 Linton House
Survey Reference: 502 design
Property: 502, London

Issued on Date: 01.Nov.2016
Prop Type Ref:

SAP Rating:	82 B	**CO2 Emissions (t/year):**	2.09	**DER:**	16.66 Pass	**TER:**	22.69	**Percentage DER<TER:**	26.58 %
Environmental:	84 B	**General Requirements Compliance:**	Pass	**DFEE:**	49.17 Pass	**TFEE:**	55.74	**Percentage DFEE<TFEE:**	11.78 %

CfSH Results **Version:** November 2010 - June 2014 Addendum **ENE1 Credits:** 3.5 **ENE2 Credits:** 0.0 **ENE7 Credits:** 0 **CfSH Level:** 4

Surveyor: Mike Ovenden, Tel: 01908 850109 Surveyor ID: H824-0001
Address: Dudley Hill, Shenley Church End, Milton Keynes, Buckinghamshire, MK5 6LL
Client: Synergy, 3

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.06r08
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

Summary Information

Property Reference: 502 Linton House
Survey Reference: 502 design
Property: 502, London

Issued on Date: 01.Nov.2016
Prop Type Ref:

SAP Rating: 82 B **CO2 Emissions (t/year):** 2.09 **DER:** 16.66 Pass **TER:** 22.69 **Percentage DER<TER:** 26.58 %
Environmental: 84 B **General Requirements Compliance:** Pass **DFEE:** 49.17 Pass **TFEE:** 55.74 **Percentage DFEE<TFEE:** 11.78 %

CfSH Results **Version:** November 2010 - June 2014 Addendum **ENE1 Credits:** 3.5 **ENE2 Credits:** 0.0 **ENE7 Credits:** 0 **CfSH Level:** 4

Surveyor: Mike Ovenden, Tel: 01908 850109 Surveyor ID: H824-0001
Address: Dudley Hill, Shenley Church End, Milton Keynes, Buckinghamshire, MK5 6LL
Client: Synergy, 3

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.06r08
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

SUMMARY FOR INPUT DATA FOR New Build (As Designed)

Orientation	East
1.0 Property Type	Flat, End-Terrace
2.0 Number of Storeys	2
3.0 Date Built	2016
3.0 Property Age Band	
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	26.03	125.25	2.60
1st Storey:	15.77	29.82	2.85

7.0 Living Area	42.66
8.0 Thermal Mass Parameter	Simple calculation - Low

9.0 External Walls

Description	Construction	U-Value	Kappa	Gross Area	Nett Area
External Wall 1	Other	0.74		67.66	31.81
External Wall 2	Other	0.74		44.96	19.77

9.1 Party walls

Description	Construction	Kappa	Area
Party Wall 1	Steel frame		76.01
Party Wall 2	Steel frame		26.69

10.0 External Roofs

Description	Construction	U-Value	Kappa	Gross Area	Nett Area
penthouse roof	Other	0.10		95.43	95.43
garden room roof	Other	0.10		29.82	29.82

11.0 HeatLoss Floors

Description	Construction	U-Value	Kappa	Area
penthouse floor	Other	0.15		125.25

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	Solar Trans	Frame Type	Frame Factor	U value
Opening Type 1	Manufacturer	Window	Double Low-E Soft 0.05			0.36		1.00	0.74

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width	Height	Count	Area	Curtain Closed
1	Window	[1] External Wall 1	West	None	0.00					1.42	
2	Window	[1] External Wall 1	West	None	0.00					9.05	
3	Window	[1] External Wall 1	West	None	0.00					7.29	

4	Window	[1] External Wall 1	West	None	0.00	7.29
5	Window	[1] External Wall 1	West	None	0.00	8.24
1gh	Window	[2] External Wall 2	West	None	0.00	24.14
6	Window	[1] External Wall 1	South	None	0.00	1.28
7	Window	[1] External Wall 1	South	None	0.00	1.28
2gh	Window	[2] External Wall 2	West	None	0.00	1.05

14.0 Conservatory None
15.0 Draught Proofing 100
16.0 Draught Lobby No

17.0 Thermal Bridging Calculate Bridges
17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported
Table K1 - Default	E19 Ground floor (inverted)	26.03	0.070	No
Table K1 - Approved	E6 Intermediate floor within a dwelling	15.77	0.070	Yes
Table K1 - Approved	E7 Party floor between dwellings (in blocks of flats)	26.03	0.070	Yes
Table K1 - Default	E14 Flat roof	15.77	0.080	Yes
Table K1 - Approved	E16 Corner (normal)	10.90	0.090	Yes
Table K1 - Approved	E18 Party wall between dwellings	10.90	0.060	Yes

18.0 Pressure Testing Yes
Designed q50 5.00
Property Tested ?
As Built q50
Same As Designed ?

19.0 Mechanical Ventilation
Mechanical Ventilation System Present Yes
Approved Installation Yes
Windows open in hot weather Windows fully open
Cross ventilation possible Yes
Night Ventilation No
Air change rate 8.00
Mechanical Ventilation data Type Database
Type Balanced mechanical ventilation with heat recovery
MV Reference Number 500320
Configuration 3
MVHR Duct Insulated No
Manufacturer SFP 0.75
Duct Type Rigid
MVHR Efficiency 78.00
Wet Rooms 3
Brand, Model

20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				0
Number of passive vents				0
Number of flueless gas fires				0

21.0 Cooling System Yes
Cooled Area 155.07
Data Source SAP table
Cooling Type Split or Multi-Split
Energy Class A
Energy Efficiency Ratio
System Control On/Off

22.0 Lighting
Internal
Total number of light fittings 52
Total number of L.E.L. fittings 52
Percentage of L.E.L. fittings 100.00
External
External lights fitted Yes
Light and motion sensors Yes
23.0 Electricity Tariff Standard

24.0 Heating Systems
Main Heating 1 SAP table
Description ashp
Percentage of Heat 100 %

Main Heating 2	None
Description	
Percentage of Heat	%
Community Heating	
Secondary Heating	None
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No

25.0 Main Heating 1	
Database Ref. No.	
Fuel Type	
Main Heating	PET
TestMethod	
SAP Code	224
Efficiency (SAP Table) %	170.0
Efficiency (SAP Table) %	
In Winter	
In Summer	
Model Name	
Manufacturer	
Controls	CHD Time and temperature zone control
PCDF Controls	0
Delayed Start Stat	
Sap Code	2207
Burner Control	
Boiler Compensator	
HETAS approved System	
Oil Pump Inside	
FI Case	
FI Water	
Flue Type	
Smoke Control Area	
Fan Assisted Flue	
Is MHS Pumped	Pump in heated space
Heat Emitter	Radiators and Underfloor
Underfloor Heating	Yes - Pipes in thin screed
Flow Temperature	<= 35°C
Electric CPSU Temperature	
Combi boiler type	
Combi keep hot type	
Combi store type	

27.0 Community Heating	
Space Community Heating	
PCDF Index	
Distribution Loss	
Distribution Loss Value	
Controls	
SAP Code	
Water Community Heating	
PCDF Index	
Distribution Loss	
Distribution Loss Value	
Charging Linked To Heat Use	

28.0 Secondary Heating	
Description	
SHS efficiency %	
SAP Code	
HETAS Approved System	
Smoke Control Area	
Test Method	
Manufacturer	
Model Name	

29.0 Water Heating	HWP From main heating 1
Water use <= 125 litres/person/day	Yes
SAP Code	901
Immersion Heater	
Summer Immersion	
Suplementary Immersion	No
Immersion Only Heating Hot Water	

29.1 Flue Gas Heat Recovery System

Database ID	
Brand Model	
Details	
29.2 Waste Water Heat Recovery System	
Total rooms with shower and/or bath	
30.0 Hot Water Cylinder	Hot Water Cylinder
Cylinder Stat	Yes
Cylinder In Heated Space	Yes
Independent Time Control	Yes
Insulation Type	Foam
Insulation Thickness	
Cylinder Volume	180.00
Loss (kwh/day)	
Pipes insulation	Fully insulated primary pipework
In Airing Cupboard	
31.0 Solar Panel	
Solar Panel Area	
Area Type	
Panel Type	
n0, a1, a2, A/G ratio	
Orientation	
Elevation	
Overshading	
Solar Storage Volume	
Pump electrically powered	
Combined Cylinder	
32.0 Thermal Store	None
Thermal Store Pipework	
33.0 Photovoltaic Unit	One Dwelling
Apportioned KWh/Year	

PV Cells kW Peak	Orientation	Elevation	Overshading
1.31	South	30°	None Or Little

34.0 Wind Turbines	
Terrain Type	Urban
Wind Turbines	
Count	
Apportioned Kwh/year	
Rotor Diameter	
Hub Height	
35.0 Small-scale Hydro	
Electricity Generated	
Description	
Apportioned kWh/Year	

Recommendations

None

Further measures to achieve even higher standards

None

Thermal Bridging

Property Reference: 502 Linton House
Survey Reference: 502 design
Property: 502, London

Issued on Date: 01.Nov.2016
Prop Type Ref:

SAP Rating:	82 B	**CO2 Emissions (t/year):**	2.09	**DER:**	16.66 Pass	**TER:**	22.69	**Percentage DER<TER:**	26.58 %
Environmental:	84 B	**General Requirements Compliance:**	Pass	**DFEE:**	49.17 Pass	**TFEE:**	55.74	**Percentage DFEE<TFEE:**	11.78 %

CfSH Results **Version:** November 2010 - June 2014 Addendum **ENE1 Credits:** 3.5 **ENE2 Credits:** 0.0 **ENE7 Credits:** 0 **CfSH Level:** 4

Surveyor: Mike Ovenden, Tel: 01908 850109 Surveyor ID: H824-0001
Address: Dudley Hill, Shenley Church End, Milton Keynes, Buckinghamshire, MK5 6LL
Client: Synergy, 3

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.06r08
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E19 Ground floor (inverted)	Table K1 - Default	0.070	26.03	1.82	
External wall	E6 Intermediate floor within a dwelling	Table K1 - Approved	0.070	15.77	1.10	
External wall	E7 Party floor between dwellings (in blocks of flats)	Table K1 - Approved	0.070	26.03	1.82	
External wall	E14 Flat roof	Table K1 - Default	0.080	15.77	1.26	
External wall	E16 Corner (normal)	Table K1 - Approved	0.090	10.90	0.98	
External wall	E18 Party wall between dwellings	Table K1 - Approved	0.060	10.90	0.65	

Total W/mK: 7.64
Y-Value W/m2K: 0.021