Agar Grove Phase 1C Energy and Sustainability Update

Rev A

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Max Fordham LLP Max Fordham LLP 42/43 Gloucester Crescent London Issue Date Description NW1 7PE * 09/08/19 Draft for Comment **T** +44 (0)20 7267 5161 А 16/08/19 Update for Planning maxfordham.com Max Fordham LLP is a Limited Liability Partnership. Registered in England and Wales Number OC300026. Registered office: 42–43 Gloucester Crescent London NW1 7PE

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ISSUE HISTORY

CONTENTS

1.0	Executive Summary	4
	1.1 Carbon Dioxide Reduction Targets	4
	1.2 Emissions Factors	4
	1.3 Key Strategies	4
	1.4 Summary of Results	5
2.0	CO ₂ Emissions	7
3.0	Fabric Performance (Be lean)	9
4.0	Heating Infrastructure (Be Clean)	9
5.0	Renewable Energy (Be Green)	12
6.0	Water, Other Resources and Sustaible Construction	15
	6.1 Water	15
	6.2 Materials and Sustainable Construction	15
7.0	Summertime Comfort and Climate Change Adaption	16
8.0	Appendix 1 – SAP modelling output	18
9.0	Appendix 2 – Overheating Report	19



1.0 EXECUTIVE SUMMARY

A Planning Application for the Regeneration of the Agar Grove Estate was submitted in December 2013. Construction of this development is phased to ensure existing residents only move once. The phasing has allowed the designs for plots I and JKL to be revisited. This energy statement provides details of the updated energy strategies for Blocks I and JKL of the Agar Grove Development.

This report is included as an update as part of the planning amendment for Blocks I and JKL.

As described in the initial application the PassivHaus standard will be used to deliver enhanced 'be lean' performance. Block by block heating systems are still proposed but will now be supplied in Blocks I and JKL by air source heat pumps. This is in line with the draft new London plan and the government's plan to phase out gas boilers. Photovoltaic panels will be located on the uppermost roofs of each building.

As a result of these measures a total carbon reduction of 64% is achieved across the residential areas of the development.

1.1 Carbon Dioxide Reduction Targets

The carbon reduction target at the time of the original application was 40% reduction over 2010 Part L requirements. This 40% overall reduction was to include a 20% reduction in carbon dioxide emissions from onsite renewables.

As the carbon intensity of the grid continues to reduce new emission factors have been released and are proposed for use by the draft London Plan. To reflect this, the carbon reduction has been calculated using SAP 10 carbon emission factors in line with the draft new London Plan and to reflect the decarbonisation of the grid. According to the Greater London Authority document 'Energy Assessment Guidance' a 35% reduction against Part L 2013 is equivalent to a 40% reduction against Part L 2010.

1.2 Emissions Factors

Unless otherwise stated SAP 10 carbon emissions have been used throughout.

Existing and new carbon dioxide emissions factors

	SAP 2012 (existing)	SAP 10 (new)
Natural Gas	0.216 kg CO2/kWh	0.210 kg CO2/kWh
Electricity	0.519 kg CO2/kWh	0.233 kg CO2/kWh

The SAP 10 carbon factors better reflect the decarbonisation of grid electricity. This results in electrically powered heat pumps being favoured for heating and means CHP engines are less beneficial in carbon terms. It also results in the perceived benefit of PVs being reduced.

1.3 Key Strategies

The key energy strategies are described below:

Be Lean- Demand Reduction



- High fabric performance- Passive House standards
- Mechanical Ventilation with Heat Recovery (MVHR) throughout

Be Clean- Efficient Energy Supply

• High efficiency MVHR

Be Green- Renewable Energy

- Air Source Heat Pumps used to provide heating and generate hot water
- PV array

1.4 Summary of Results

The proposed development has been remodelled in SAP incorporating the fabric and servicing strategy changes described above.

Domestic Block I – SAP Summary



Figure 1: Domestic energy hierarchy and targets Block I, kgC02/m2

Table 1: CO2 emissions after each stage of the Energy Hierarchy for Block I

	Carbon dioxide emissions for domestic buildings (tonnes CO2 per annum)
	Regulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	37.6
After energy demand reduction	32.7
After heat network / CHP	30.1
After renewable energy	13.2



Block JKL Summary



Figure 2 Domestic energy hierarchy and targets Block JKL, kgC02/m2

Table 2: CO2 emissions after each stage of the Energy Hierarchy for Block JKL

	Carbon dioxide emissions for domestic buildings (tonnes CO2 per annum)
	Regulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	85.2
After energy demand reduction	73.2
After heat network / CHP	67.2
After renewable energy	30.6

Table 3: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domesti savings-Block	ic carbon dioxide ks I and JKL
	(Tonnes CO ₂ per annum)	(%)
Savings from energy demand reduction	16.95	13.8
Savings from heat network / CHP	8.7	7.1
Savings from renewable energy	53.4	43.5
Cumulative on site savings	79.1	64.3



2.0 CO₂ EMISSIONS

The carbon footprints as shown in the tables above have been calculated using the following methods:

Dwellings:

A Dwelling Emissions Rate (DER) has been calculated in line with the Building Regulations Part L 2013 methodology SAP 2012. The results have then been converted using SAP 10 carbon factors.

These calculations were carried out on a representative sample of properties as shown below. Details of the results of these calculations can be found in Appendix 1









Shop:

The non-domestic unit in block JKL will be provided as a shell and core shop. This has been excluded from the modelling as it will have the same thermal envelope as the domestic units and will be provided without services.



3.0 FABRIC PERFORMANCE (BE LEAN)

As described in the previous planning report carbon emissions will be reduced primarily b implementing 'passive' energy efficiency measures. Blocks I and JKL have been designed based on the Passivhaus approach.

It is recognised that Passivhaus is better at delivering lower energy in use than the SAP methodology. This is in part because it is much more rigorous in its requirements for certification in terms of the Passivhaus Planning Package model, the certified mechanical equipment, and the construction detailing.

Fabric performance targets have not changed since the original planning application.

4.0 HEATING INFRASTRUCTURE (BE CLEAN)

High efficiency gas condensing boilers were previously selected; as guidance has changed the heat source selection has been revisited.

Connection to existing networks

As described in the original planning application connection to the existing King's Cross Argent network would not be feasible as the route would require crossing a major railway line and the existing boiler house has no spare capacity.



No new heat networks have been developed in the area since the previous application.

Site wide district heating network

The GLA have allowed that CHP is not required for this scheme.

A site wide network was deemed inappropriate due to the phased delivery of the development and objections raised by residents during consultation.

The new blocks will not connect to a site wide heat network; a block-by-block system will be installed. This allows a lower system temperature, and shorter pipe runs, hence reduced losses. This improves efficiency.



Decarbonisation of the Grid

When looking at energy efficiency it is also useful to consider fuel sources and their carbon efficiency. Heating and hot water provided by natural gas boilers was previously proposed for the site. This is becoming a relatively carbon intense fuel. Meanwhile mains electricity is becoming a relatively low carbon fuel.

The current carbon intensity of the UK electricity grid is considerably lower than the factors written into the 2013 Part L of the Building Regulations. An update to Part L is expected in 2019/2020. This will include updating carbon emission factors which are more representative of the real world. These updated carbon emission factors have already been released as part of the latest version of the standard Assessment Procedure (SAP 10). These carbon factors have been used for our analysis where stated as they give a more accurate representation of current carbon emissions factors.

As more renewable technologies are used to supply the electricity grid it is expected that this figure will continue to reduce. In terms of carbon reduction, efficient all electric systems are preferable. This is shown in the Department of Energy and Climate Change Energy and Emissions Predictions.

The solid blue line in the following graph shows how the carbon intensity of the UK grid is predicted to drop based on 2017 predictions, and the dashed blue line is the same measure based on 2016 predictions.



Department of Energy and Climate Change (DECC) Energy and Emissions Predictions (EEP) for 2017 and 2016.

Heat Source Selection

As previously discussed the new SAP 10 carbon emission rates more accurately reflect the carbon intensity of the electricity grid. Electricity driven heat pumps are more favourable using these values. This is shown below, a study was undertaken to compare gas fired boilers and electricity driven air source heat pumps using SAP10 emissions rates.





Air source heat pumps show much lower Dwelling Emission Rates (DERs) compared to gas boilers. Air source heat pumps will be discussed in further detail in the renewables section below.





5.0 RENEWABLE ENERGY (BE GREEN)

Heat pumps have been identified in the previous section as a more suitable heat source than gas boilers due to decarbonisation of the grid. This change in heat source will impact the selection of supplementary renewable technologies chosen.

Air Source Heat Pumps

A heat pump is akin to a domestic fridge: it uses electricity to move heat from one material to another. An air source heat pump moves heat from the outside air to a fluid (water). It uses a refrigerant to achieve this, and generally uses electricity as a power source. Figure 1 shows the four stages of a typical ASHP cycle.

As the ASHP is moving heat from one location to another, it is possible to transfer more heat than the energy put in. This is generally defined by the Coefficient of Performance (COP):

 $COP = \frac{Useful heat transferred}{Energy Input}$

So a heat pump that moved 3kW of heat for 1kW of electrical power input would have a COP of 3. The COP is generally higher the closer the air and water temperatures are to each other.

This heat pump is generally mounted externally, and pipework then brought to within the building - Figure 2 shows example units.

Climate Change

Recent years have seen particularly warm summers, which are anticipated to continue with ongoing climate change, as shown in Figure 4. Carbon emissions contribute to climate change, so there is a responsibility to choose low-carbon solutions where possible.

The increasing temperatures also mean that summer comfort is increasingly becoming a concern. This means designs should allow for future climate change, and ideally ensure comfortable conditions can be achieved, including the provision of comfort cooling where passive measures will be inadequate.

Passivhaus Primary Energy Assessment

For the Passivhaus standard, the anticipated total energy consumption of the building is modelled. Whereas this has been done for specifically Agar Grove which is designed to Passivhaus standards, the results give a useful indication of in-use energy consumption, with numbers more reliable than those associated with Building Regulations compliance.

Proposed System and Rationale

The proposed system uses an external air source heat pump to generate warm water. This warm water is then circulated around the building at low temperatures (circa 25°C). The distribution losses are therefore significantly lower than a conventional system (which would have water temperatures around 55-70°C, depending on the system choice), and once a space reaches 25°C they become zero. As these losses are lower, the risk of overheating in corridors and other circulation spaces is significantly reduced.



In-apartment water to water heat pumps then produce warm water at suitable temperatures for both domestic hot water production and space heating. These in-apartment proprietary units contain a hot water tank, water to water heat pump, and associated controls. The principal elements of the system are shown in the images below.



The principal benefits of this system are:

- Efficiency: the use of air source heat pumps in this arrangement mean distribution losses are minimised, and space heating and domestic hot water production are achieved efficiently
- Environmental impact: the use of electricity is consistent with a decarbonising electricity grid, and a design that is aligned with limiting environmental impact
- Compliance: the use of electricity is in line with the draft new London Plan
- Air quality: the use of electricity means there is no combustion on the site, and so no omission of particulates, or incomplete products of combustion (NO_x etc.)
- Future-proofing: the terminal units can provide both heating and cooling, which allows for the provision of comfort cooling within apartments either initially or in the future, without requiring a change in infrastructure throughout the building
- Passivhaus compliance: the use of electricity, and low energy consumption of the system align with the stringent energy requirements of Passivhaus.
- The ambient loop can readily make use of low-grade waste heat in the area, should it become available in future.



The principal risks are related to the relatively new technology: there are two manufacturers in the UK offering a system of this type (Dimplex and Daikin), with demonstration systems but not completed projects



In-apartment terminal unit, containing heat pump, hot water tank, and associated pumps and controls

Supplementary renewable technologies

The original planning application identified solar thermal collectors and photovoltaic (PV) panels as the most appropriate renewable technologies for the site. As the heat source for Block I and JKL is being changed the suitability of these technologies has been reviewed.

Incorporating solar thermal collectors into the proposed system would be difficult. Hot water generated by the solar thermal collectors will be at a higher temperature than the warm water generated by the air source heat pump and cannot be added to the ambient loop system. A separate system would be required to provide the hot water from the solar thermal collectors to dwellings. Additionally the in-apartment terminal units are not capable of taking a secondary heat source.

It is instead proposed that PV panels only are installed on the highest roofs.



6.0 WATER, OTHER RESOURCES AND SUSTAIBLE CONSTRUCTION

The sustainability approach beyond energy and carbon dioxide remains largely unchanged from the original planning application.

6.1 Water

Domestic water consumption is deigned to achieve 105 litres/person/day.

The landscaping strategy also includes the provision of SUDS to the Mayor's preferred standard through green roofs, permeable paving and rain gardens.

6.2 Materials and Sustainable Construction

The aspiration for Passivhaus means a higher embodied energy than a typical building because of the additional insulation required and additional glazing in the triple glazed windows. Wherever possible preference will be given to environmentally low impact materials: cement replacements will be specified in order to reduce the impact of concrete elements; the insulation used will not contain substances known to contribute to ozone depletion or have the potential to contribute to global warming.



7.0 SUMMERTIME COMFORT AND CLIMATE CHANGE ADAPTION

Introduction

Anthropomorphic climate change is a becoming prominent global concern, with significant potential detrimental results, primarily due to the speed of change and the difficulty in adapting to this. Climate change is shifting Britain's climate towards hotter summers with increased probabilities of extended heatwaves. The UK government and Camden council have both introduced legislation to ensure new developments address this issue on two fronts.

- 1. Reduce carbon emissions to limit the severity of climate change- minimise energy use.
- 2. Ensure developments are resilient to increased overheating risks from future climate scenarios.

The Camden Local Plan 2017 calls for following the London Plan Cooling Hierarchy which aims to reduce overheating risk whilst also reducing reliance on air conditioning systems.

As described in the original application, the design team has been aware from an early stage of the need to mitigate the risk of overheating; and to create thermally comfortable spaces that will continue to operate successfully in future climates. The fact that the development is targeting Passivhaus certification reinforces the requirement for acute attention to detail with respect to overheating, as Passivhaus relies on a highly insulated thermal envelope resulting very low heat loss. In the winter, this allows the dwelling to take advantage of Solar Gains for free heating, but in the summer affective strategies to control gain and flush away heat must be considered.

To reduce energy demand from cooling, the design follows the London Plan Cooling Hierarchy by adopting a passive design - opening windows for natural ventilation. However, there is a greater risk of overheating, both with the current and predicted future climate with a natural ventilation strategy. Therefore an overheating analysis was completed with the aims of showing compliance with legislation whilst also driving the design.

Methodology

The design standards for residential summer comfort have advanced since the original application. In line with the draft New London Plan, CIBSE's TM59 was used as the framework to assess overheating risk and to guide design to militate against this. TM59 has two criteria to pass – daytime comfort for all rooms, and night-time comfort for bedrooms. Ten apartments which represent the most onerous examples were analysed. This included apartments with higher solar gains due to being south facing and/or limited shading, single aspect glazing which doesn't allow cross flow and ground floor apartments where security issues mean limited opening of windows.

Results

• 2020 Climate:

Results showed it was feasible to adopt a passive cooling design ONLY if certain features are adopted, such as solar irradiance filters on the glazing, ensuring sufficient opening areas on the glazing and adopting external shading. Refer to the TM59 Summer Comfort report for full details.

• 2050 Climate

Current passive design measures will not be sufficient in mitigating the overheating risk. Solar irradiance is the most significant heat gain.

Following the London Plan Energy Hierarchy 'Be Lean, be clean, be green', the first option should 'be lean' adopting more passive design measures which will bring down energy demand. Measures that could be adopted now include adding blinds/shades/louvres to limit solar gains and the removal of fixed low level glazing which adds to solar gains but does not aid natural ventilation. Retrofit options in the future include providing solar control film, fitting more external shading/louvres and adding ceiling fans.



The above measures will reduce the demand for active cooling but not eliminate it. Following 'be clean', active cooling could be retrofitted by modifying the currently proposed underfloor heating system to be able to also provide underfloor cooling, or alternatively add cooling to the mechanical ventilation system. To 'be clean' this should utilise air source heat pumps with high efficiency ratings (SCOP and SEER).

Further details can be found in Appendix 2.





8.0 APPENDIX 1 – SAP MODELLING OUTPUT

Modelling of regulated energy in the dwellings was carried out using STROMA FSAP software in line with the methodology and occupancy profiles described in Part L 2013 of the Building Regulations. Results were then converted using SAP10 factors in line with the guidance provided by the GLA. The following pages contain examples of the modelling output at each stage of the energy hierarchy.



		Use	er Details:						
Assessor Name: Software Name:	Stroma FSAP 2012	2	Stroma Softwa	a Numi ire Ver	ber: sion:		Versio	n: 1.0.4.18	
		Prope	erty Address:	11_s_m	1				
Address :	Block I, Agar Grove,	Camden, Lo	ondon, NW1	9TB					
1. Overall dwelling dime	ensions:		(m ²)			iaht(m)		Volumo(m ³)	
Ground floor			77.6	(1a) x	АV. Пе	.15	(2a) =	244.44	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)	+(1n)	77.6	(4)					
Dwelling volume				(3a)+(3b)	+(3c)+(3d	l)+(3e)+	.(3n) =	244.44	(5)
2. Ventilation rate:	·								
	main se heating he	condary eating	other		total			m ³ per hour	•
Number of chimneys	0 +	0 +	0] = [0	x 4	= 0	0	(6a)
Number of open flues	0 +	0 +	0] = [0	x 2	20 =	0	(6b)
Number of intermittent fa	ns			, r	0	x 1	0 =	0	(7a)
Number of passive vents	i				0	x 1	0 =	0	(7b)
Number of flueless gas fi	res				0	× 4	40 =	0	(7c)
							Air ch	ange <mark>s per</mark> ho	ur
Infiltration due to chimne	ys, flues and fans = (6a)+(6b)+(7a)+(7	/b)+(7c) = 17) otherwise c	ontinue fro	0	(16)	÷ (5) =	0	(8)
Number of storeys in the	ne dwelling (ns)	a, proceed to (, (o) to (10)	[0	(9)
Additional infiltration						[(9)-	1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber fi	rame or 0.35	5 for masonr	y constr	uction			0	(11)
if both types of wall are pl	resent, use the value corresp	onding to the g	greater wall area	a (after					
If suspended wooden f	iloor. enter 0.2 (unseale	ed) or 0.1 (se	ealed), else	enter 0			[0	T (12)
If no draught lobby, en	ter 0.05, else enter 0	, (,,					0	(13)
Percentage of windows	s and doors draught str	ipped						0	(14)
Window infiltration			0.25 - [0.2	x (14) ÷ 1	= [00			0	(15)
Infiltration rate			(8) + (10) -	+ (11) + (1	2) + (13) +	+ (15) =		0	(16)
Air permeability value,	q50, expressed in cubi	c metres pe	r hour per so	quare me	etre of e	nvelope	area	1	(17)
If based on air permeabil	ity value, then $(18) = [(17)]$	') ÷ 20]+(8), oth	nerwise (18) = (16)				0.05	(18)
Air permeability value applie	es if a pressurisation test has	been done or a	a degree air per	meability i	s being us	sed	r		
Shelter factor	iu		(20) = 1 - [0.075 x (1	9)] =			0.85	(19)
Infiltration rate incorporat	ing shelter factor		(21) = (18)	x (20) =			l	0.03	(20)
Infiltration rate modified f	or monthly wind speed						l	0.04	
Jan Feb	Mar Apr May	Jun Ju	ul Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	eed from Table 7	•							
(22)m= 5.1 5	4.9 4.4 4.3	3.8 3.	8 3.7	4	4.3	4.5	4.7		
Wind Factor $(22a)m = (22a)m $	2)m ÷ 4			I					
(22a)m= 1.27 1.25	1.23 <u>1.1</u> 1.08	0.95 0.9	95 0.92	1	1.08	1.12	1.18		

Adjust	ed infiltr	ation rat	e (allow	ing for sh	nelter an	d wind s	peed) =	(21a) x	(22a)m				_	
_	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.05		
Calcul	ate effe	ctive air	change	rate for t	he appli	cable ca	se		-		-	-	- 	
IT ME	ecnanica			" N (0		、 - (. (00)				0.5	(23a)
If exh	aust air h	eat pump (using App	endix N, (2	(23a) = (23a	i) × Fmv (e	equation (P	N5)), othe	rwise (23b) = (23a)			0.5	(23b)
lf bala	anced with	heat reco	overy: effic	iency in %	allowing f	or in-use f	actor (from	n Table 4h) =				76.5	(23c)
a) If	balance	ed mecha	anical ve	entilation	with hea	at recove	ery (MVI	HR) (24a	a)m = (22	2b)m + (1	23b) × [1 – (23c)) ÷ 100]	
(24a)m=	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17		(24a)
b) If	balance	ed mecha	anical ve	entilation	without	heat rec	overy (N	ИV) (24b)m = (22	2b)m + (2	23b)	-	_	
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If	whole h	ouse ex	tract ver	ntilation of	or positiv	e input v	ventilatio	on from c	outside					
i	if (22b)n	n < 0.5 ×	(23b), t	then (24	c) = (23b); otherv	wise (24	c) = (22b	o) m + 0.	5 × (23b)	-	-	
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If	natural	ventilatio	on or wh	ole hous	se positiv	ve input	ventilatio	on from l	oft					
i	if (22b)n	n = 1, the	en (24d) I	m = (22t	o)m othe	erwise (2	4d)m = 0	0.5 + [(2	2b)m² x	0.5]			1	(N
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effe	ctive air	change	rate - er	nter (24a) or (24t	o) or (24	c) or (24	d) in boy	k (25)				-	
(25)m=	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17]	(25)
3. He	at losse	s and he	at loss	paramete	er:									
		Gros	s	Openin	as	Net Ar	ea	U-valı	ue	AXU		k-valu	e	AXk
		are <mark>a</mark>	(m²)	m	12	A ,r	n²	W/m2	2K	(W/I	K)	kJ/m ² ·	K	kJ/K
Windo	ws Type	e 1				5.6	×1/	[1/(0.85)+	+ 0.04] =	4.6				(27)
Windo	ws Type	2				11.1	x1/	[1/(0.85)+	+ 0.04] =	9.12				(27)
Walls ⁻	Type1	38.4	4	11.1		27.3	X	0.2	i - T	5.46	Fir			(29)
Walls ⁻	Tvpe2	8.5		5.6		29		0.2		0.58			= =	(29)
Total a	irea of e		m ²			46.0		0.2	[0.00	L			(31)
* for win	dows and	roof winde	, ows. use e	effective wi	ndow U-va	alue calcul	 ated usino	i formula 1	/I(1/U-valu	ie)+0.041 a	as aiven in	paragrap	h 3.2	(01)
** inclua	le the area	as on both	sides of i	nternal wal	ls and part	titions	atou aonig	, ionnaid i	//(<i>ii</i> /c ⁻ /aia	<i></i>	ie gireir ii	purugrup		
Fabric	heat los	s, W/K =	= S (A x	U)				(26)(30)) + (32) =				19.77	(33)
Heat c	apacity	Cm = S((Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	513.4	(34)
Therm	al mass	parame	ter (TMI	⊃ = Cm ÷	- TFA) ir	n kJ/m²K			Indica	tive Value	: Low		100	(35)
For desi	gn assess	sments wh	ere the de	etails of the	construct	ion are not	t known pr	ecisely the	e indicative	values of	TMP in T	able 1f		
can be ι	ised inste	ad of a dei	tailed calc	ulation.										
Therm	al bridge	es : S (L	x Y) cal	culated u	using Ap	pendix ł	<						7.04	(36)
if details	of therma	al bridging	are not kr	10wn (36) =	= 0.05 x (3	1)			(00)	(00)			r	
	abric ne	atioss							(33) +	(36) =			26.8	(37)
Ventila	ition hea	at loss ca		monthly	y 				(38)m	= 0.33 × (25)m x (5 1)	1	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		()
(38)m=	13.85	13.76	13.68	13.25	13.16	12.74	12.74	12.65	12.91	13.16	13.33	13.51	J	(38)
Heat tr	ansfer o	coefficier	nt, W/K						(39)m	= (37) + (3	38)m		-	
(39)m=	40.65	40.57	40.48	40.05	39.97	39.54	39.54	39.45	39.71	39.97	40.14	40.31		
11				/						Average =	Sum(39)	12 /12=	40.03	(39)
Heat lo	oss para	imeter (H	ΗLΡ), W	/m²K				<u> </u>	(40)m	= (39)m ÷	• (4)	<u> </u>	1	
(40)m=	0.52	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.51	0.52	0.52	0.52		
									1	Average =	Sum(40)	₁₂ /12=	0.52	(40)

Numbe	er of day	rs in moi	nth (Tab	le 1a)			-		-	-	-	-		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Wa	ater heat	ing enei	rgy requ	irement:								kWh/ye	ear:	
Assum if TF if TF	ied occu A > 13.9 A £ 13.9	ipancy, l 9, N = 1 9, N = 1	N + 1.76 x	[1 - exp	(-0.0003	349 x (TF	⁻ A -13.9)2)] + 0.(0013 x (⁻	TFA -13.	<u>2</u> . 9)	42		(42)
Annua Reduce not more	l averag the annua e that 125	e hot wa Il average litres per l	ater usag hot water person pel	ge in litre usage by r dav (all w	es per da 5% if the d ater use. I	ay Vd,av Iwelling is not and co	erage = designed i ld)	(25 x N) to achieve	+ 36 a water us	se target o	91 f	.57		(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Αυσ	Sen	Oct	Nov	Dec		
Hot wate	er usage in	n litres per	day for ea	ach month	Vd,m = factor	ctor from T	Table 1c x	(43)	000	000	1107	200		
(44)m=	100.73	97.07	93.41	89.74	86.08	82.42	82.42	86.08	89.74	93.41	97.07	100.73		
Energy	content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,n	n x nm x D)))))))))))))))))))) kWh/mor	Total = Su oth (see Ta	m(44) ₁₁₂ = ables 1b, 1	= c, 1d)	1098.89	(44)
(45)m=	149.38	130.65	134.82	117.54	112.78	97.32	90.18	103.49	104.72	122.04	133.22	144.67		
				1					-	Total = Su	m(45) ₁₁₂ =		1440.81	(45)
lf instan	taneous w	ater heatil	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46) to (61)					
<mark>(46)m=</mark> Water	22.41	19.6	20.22	17.63	16.92	14.6	13.53	15.52	15.71	18.31	19.98	21.7		(46)
Storag	e volum	e (litre <mark>s</mark>)	includir	ng any so	olar or W	WHRS	storage	within sa	ame ves	sel		0		(47)
lf co <mark>m</mark> Otherv Water	munity h vise if no storage	eating a stored loss:	ind no ta hot wate	ink in dw er (this ir	velling, e ncludes i	nter 110 nstantar) litres in neous co	(47) ombi boil	ers) ente	er '0' in (47)			
a) I <mark>f m</mark>	anufact	urer's de	eclared I	oss facto	or is kno	wn (kWr	n/day):					0		(48)
Tempe	erature fa	actor fro	m Table	2b								0		(49)
Energy	/ lost fro	m water	storage	e, kWh/ye	ear loss facto	or is not	known:	(48) x (49)) =		1	10		(50)
Hot wa	ater stora munity h	age loss eating s	factor fr	om Tabl	e 2 (kWl	h/litre/da	ay)				0.	02		(51)
Volum	e factor	from Ta	ble 2a								1.	03		(52)
Tempe	erature fa	actor fro	m Table	2b							0	.6	_	(53)
Energy	/ lost fro (50) or (m water 54) in (5	storage	e, kWh/y€	ear			(47) x (51)) x (52) x (53) =	1.	03		(54) (55)
Water	storage	loss cal	culated t	for each	month			((56)m = (55) × (41)ı	m	L1.	03		(00)
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(56)
If cylinde	er contains	dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (L H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	l lix H	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(57)
Primar	y circuit	loss (ar	nual) fro	om Table	e 3							0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m cylinder	r thormo	stat)			
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss cal	culated	for each	month ((61)m =	(60) ÷ 36	65 × (41)m		I	I		I	
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)

(e2)m 20.4 68 190.5 171.0.3 190.08 150.82 145.46 158.72 178.22 177.22 188.71 198.84 (e2) Stati DHW nput calculated using Appendix G or Appendix H (regative quantity) (rentry U in o solar cambulanto to water heating) (add additional lines if FGHRS applies, see Appendix G) Using the solar cambulanto to water heating) (e3)m 0 </th <th>Total h</th> <th>leat req</th> <th>uired for</th> <th>water h</th> <th>neatin</th> <th>g calcul</th> <th>ated</th> <th>fo</th> <th>r each</th> <th>n month</th> <th>(62)</th> <th>m =</th> <th>0.85 × (</th> <th>(45)r</th> <th>n +</th> <th>(46)m +</th> <th>(57)r</th> <th>m +</th> <th>(59)m + (61)m</th> <th></th>	Total h	leat req	uired for	water h	neatin	g calcul	ated	fo	r each	n month	(62)	m =	0.85 × ((45)r	n +	(46)m +	(57)r	m +	(59)m + (61)m	
Salar CMV input actualized using Appendix H meganity (emery V in a salar contribution to water heating) (add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (63) Output from water heater (64)m 20.66 180.58 180.1 171.03 168.06 150.82 145.46 158.76 158.22 177.32 186.71 199.94 (64)m 20.66 180.58 180.1 171.03 168.06 150.82 145.46 158.76 158.22 177.52 186.71 199.94 (64)m 20.66 180.58 180.1 171.03 168.06 150.82 145.46 158.76 158.22 177.52 186.71 199.94 (64)m 20.66 180.58 180.1 171.03 168.06 150.82 145.46 158.76 158.22 177.52 186.71 199.94 (65)m 20.88 83.88 80.05 81.88 81.72 76.15 74.21 78.63 77.62 84.8 87.09 92.32 (65) Include (57)m in calculation of (65)m only if cylinder is in the dwalling or hot water is from community heating 5. Internal quite Scee Table 5 and 5.5 : Wetabolic gains (Table 5), Watts (68)m 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 (65) (17)m 484.8 43.07 35.03 26.52 188.8 16.73 18.08 22.63 31.55 40.88 46.75 40.84 (65) (17)m 484.8 43.07 35.03 26.52 188.8 16.73 18.08 22.63 31.55 40.88 46.75 40.84 (67) Appliances gains (calculated in Appendix L, equation L15 or L1530 / also see Table 5 (67)m 484.8 43.07 35.03 26.52 188.8 16.73 18.08 22.64 31.55 40.88 46.75 40.84 (67) Appliances gains (calculated in Appendix L, equation L15 or L1530 / also see Table 5 (67)m 484.8 43.07 35.03 26.52 188.8 10.15 0 / L1530 / also see Table 5 (69)m 51.91 51.9	(62)m=	204.66	180.58	190.1	171	03 168	3.06	15	50.82	145.46	158	.76	158.22	177	7.32	186.71	199	.94		(62)
(add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (a) 0	Solar DI	-IW input	calculated	using Ap	pendix	G or App	endix	Н (negativ	/e quantity	v) (ent	er '0'	if no solai	r cont	tribu	tion to wate	er heat	ting)		
	(add a	dditiona	I lines if	FGHR	and/	or WWI	HRS	ар	plies,	see Ap	penc	lix C	3)	-						
Output from water heater (64)m 204.86 180.58 190.1 171.03 186.06 150.82 145.46 158.62 177.32 186.71 199.94 Upput from water heating, kWh/month 0.25 10.85 × (45)m + (61)m) + 0.8 × [(46)m + (67)m + (59)m] 2091.65 (64) (69)m 93.88 83.38 90.05 81.88 81.72 75.15 74.21 78.63 77.62 84.8 87.09 92.32 (65) Include (57)m in calculation of (65) mony if cylinder is in the dwelling or hot water is from community heating 5. Include (57)m in calculation of (65) mony if cylinder is in the dwelling or hot water is from community heating 660m 144.94 144.9	(63)m=	0	0	0	0	()		0	0	0)	0	()	0	0)		(63)
(64)me 204.66 180.58 190.1 171.03 168.06 150.82 145.46 158.76 158.22 177.32 188.71 199.94 0.00 0.05 (64) 0.00 0.00 0.201.65 (64) 93.89 03.38 08.05 81.88 0.17.2 75.15 77.42 17.83 77.62 04.8 87.09 92.32 (65) 03.89 03.38 08.05 81.88 0.17.2 71.5 77.42 17.83 77.62 04.8 87.09 92.32 (65) 180.45 5.0 17.24 78.63 77.62 04.8 87.09 92.32 (65) 199.4 Mar	Output	from w	ater hea	ter																
Undput from water heating, kWh/month 0.25 (0.85 x (45)m + (61)m) + 0.8 x [(46)m + (57)m + (59)m] (64) (65)m 93.89 83.38 89.05 81.88 81.72 75.15 74.21 78.63 77.62 84.8 87.09 92.32 (65) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from comunity heating 5.	(64)m=	204.66	180.58	190.1	171	03 168	3.06	15	50.82	145.46	158	.76	158.22	177	7.32	186.71	199	.94		_
Heat gains from water heating, kWh/month 0.25 ¹ [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] (65)m 9 8.89 8.38 8.06 81.88 81.72 75.15 74.21 78.63 77.62 84.8 87.09 82.32 (65) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Internal gains (see Table 5 and 53) : Metabolic gains (Table 5), Wats (66)m 1 141.94 144.94 149.94 1			-									Outp	out from wa	ater h	eate	er (annual) _{1.}	12		2091.65	(64)
(66)me 93.89 83.38 89.05 81.88 81.72 75.15 74.21 78.63 77.62 84.8 87.09 92.32 (65) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Total agins (see Table 5 and 5a): Water Main Apr May Jun Jul Aug Sep Oct Nov Dec (66) (66)me 144.94<	Heat g	ains fro	m water	heating	, kWł	n/month	0.2	5 í	[0.85	× (45)m	+ (6	1)m	ı] + 0.8 x	c [(46	6)m	+ (57)m	+ (5	9)m]	
Include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Internal gains (caee Table 5). Wates Metabolic gains (Table 5). Wates (60)m = $\begin{bmatrix} 144.94 \\ 144.94 $	(65)m=	93.89	83.38	89.05	81.	38 81	.72	7	5.15	74.21	78.	63	77.62	84	.8	87.09	92.3	32		(65)
5. Internal gains (see Table 5). Watts Jan Feb Mar Apr May Jun Jun Aug Sep Oct Nov Dec (66)m= 144.94 1	inclu	ide (57)	m in calo	culation	of (6	5)m only	/ if c	ylin	der is	s in the c	dwell	ing	or hot w	ater	is f	rom com	muni	ity h	eating	
$ \begin{array}{ccccc} detabolic qains (Table 5), Watts \\ \mbox{detabolic qains (Calculated in Appendix L, equation L9 or L9a), also see Table 5 \\ \mbox{detabolic qains (Calculated in Appendix L, equation L13 or L13a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L13 or L13a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L13 or L13a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L15 or L15a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L15 or L15a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L15 or L15a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L15 or L15a), also see Table 5 \\ \mbox{detabolic qains (Table 5a) \\ \mbox{detabolic qains (Table 5b) \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to th$	5. Int	ternal g	ains (see	Table	5 and	5a):														
$ \begin{array}{ c c c c c c } \hline \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Metab	olic gair	ns (Table	5) Wa	tte															
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	motab	Jan	Feb	Mar		or M	1ay		Jun	Jul	A	ug	Sep	С	Oct	Nov	D	ec		
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (67) m 48.49 43.07 35.03 26.52 19.82 16.73 18.08 23.5 31.55 40.06 46.75 49.84 (67) Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68) m 319.93 323.25 314.88 297.07 274.59 253.46 239.34 230.02 244.39 26.22 284.68 305.81 (68) Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69) m 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 (70) m 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(66)m=	144.94	144.94	144.94	144	94 144	.94	14	4.94	144.94	144	.94	144.94	144	.94	144.94	144	.94		(66)
	Liahtin	a aains	(calcula	ted in A	ppen	dix L. ed	nuati	on	L9 or	[.] L9a), a	lso s	ee T	Table 5							
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68) = $319.33 323.25 314.88 297.07 274.59 253.46 239.34 236.02 244.39 262.2 284.68 305.81 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 (69) = 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91(69) Pumps and fans gains (Table 5a)(70) • 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0$	(67)m=	48.49	43.07	35.03	26.	52 19	.82	1	6.73	18.08	23.	.5	31.55	40.	.06	46.75	49.8	84		(67)
$ \begin{array}{c} \text{(a)} \text{m} & 3 \text{ (b)} (b)$	Applia	L	ins (calc	ulated i	n Apr	endix I	ea	uat	ion I 1	13 or l 1	3a) ;	also	see Tal	ble 5	5					
Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated uses) (calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Core Calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. FF Gains (W) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 e3.91 (76) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 e3.91 (76) East 0.9x 0.54 x	(68)m=	319.93	323.25	314.88	297	07 274	, 0 9	25	3.46	239.34	236	.02	244.39	26	2.2	284.68	305	.81		(68)
Counting gains (calculated in popertux 2, equation 1215 of 2104) and one rable 3 (69) m $51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 (70) The set of 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 $	Cookir			ited in /	nnen		quat	ion	1 15	or 15a)	ale	0.56	Table	5						
Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2"C	(69)m-	51 91	51 91	51 91	51		91	5	1 91	51 91	51	91	51 91	51	91	51 91	51.0	91		(69)
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Dump	and fo		(Table	50)			Ŭ			01.	<u> </u>	01.01		.01	01.01	01.	01		()
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	(70)m-				5a)				0	0	0		0		<u> </u>	0	0	1		(70)
Losses e.g. evaporation (negative values) (Table 5) (71)m = $\frac{-96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63}$ (71) Water heating gains (Table 5) (72)m = $\frac{126.2}{124.08} \frac{119.69}{119.69} \frac{113.72}{109.84} \frac{104.38}{104.38} \frac{99.74}{99.74} \frac{105.69}{107.8} \frac{107.8}{113.98} \frac{120.96}{124.09}$ (72) Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m = $\frac{594.84}{590.62} \frac{599.82}{597.53} \frac{504.48}{504.48} \frac{474.8}{457.39} \frac{465.44}{483.96} \frac{483.96}{516.46} \frac{552.62}{52.62} \frac{579.97}{57.97}$ (73) 6. Solar gains Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux g_{-} FF Gains Table 6b Table 6c (W) East $0.9x 0.54 \times 11.1 \times 19.64 \times 0.5 \times 0.8 = \frac{42.38}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times \frac{63.27}{11.1} \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 113.09 \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 113.09 \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 0.57 \times 0.5 \times 0.8 = \frac{244.04}{10.6} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 115.77 \times 0.5 \times 0.8 = \frac{244.04}{10.6} (76)$ East $0.9x 0.54 \times 11.1 \times 111.0 \times 0.5 \times 0.8 = \frac{244.04}{10.6} (76)$ East $0.9x 0.54 \times 11.1 \times 111.0 \times 0.5 \times 0.8 = \frac{249.81}{10.6} (76)$ East $0.9x 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = \frac{237.83}{10.6} (76)$ East $0.9x 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = \frac{237.83}{10.6} (76)$ East $0.9x 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = \frac{237.83}{10.6} (76)$ East $0.9x 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = \frac{237.83}{1$							/ T = h		-\		0	,	Ū			Ū	0	,		(10)
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Losses			n (nega		alues) ($\frac{(c)}{(c)}$	06.62	00	60	06.62	00	60	06.62	00	60	I	(71)
Water heating gains (1able 5) (72)me 126.2 124.08 119.69 113.72 109.84 104.38 99.74 105.69 107.8 113.98 120.96 124.09 (72) Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)me 594.84 590.62 569.82 537.53 504.48 457.39 465.44 483.96 516.46 552.62 579.97 (73) 6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux 9 0.5 x 0.8 = 42.38 (76) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 42.38 (76) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 136.53 (76) East 0.9x 0.54 x 11.1 x 132.7 x<	(71)m=	-90.03	-90.03	-90.03	-96	03 -90	.03	-9	0.03	-90.03	-90.	.03	-90.03	-90	0.03	-90.03	-90.	.03		(71)
$ \begin{array}{c} (72) \text{m} = & 126.2 & 124.08 & 119.69 & 113.72 & 109.84 & 104.38 & 99.74 & 105.69 & 107.8 & 113.98 & 120.96 & 124.09 & (72) \\ \hline \text{Total internal gains = } & (66) \text{m} + (67) \text{m} + (68) \text{m} + (69) \text{m} + (70) \text{m} + (71) \text{m} + (72) \text{m} \\ \hline (73) \text{m} = & 594.84 & 590.62 & 569.82 & 537.53 & 504.48 & 474.8 & 457.39 & 465.44 & 483.96 & 516.46 & 552.62 & 579.97 & (73) \\ \hline \text{G. Solar gains} \\ \hline \text{G. Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \hline \text{Orientation: Access Factor Table 6d m^2 Table 6a & Table 6a & Table 6b Table 6c & (W) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 19.64 & \times & 0.5 & \times & 0.8 & = & 42.38 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 63.27 & \times & 0.5 & \times & 0.8 & = & 136.53 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 92.28 & \times & 0.5 & \times & 0.8 & = & 199.13 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 113.09 & \times & 0.5 & \times & 0.8 & = & 199.13 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 113.09 & \times & 0.5 & \times & 0.8 & = & 244.04 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 113.09 & \times & 0.5 & \times & 0.8 & = & 244.04 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 113.09 & \times & 0.5 & \times & 0.8 & = & 244.04 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 113.09 & \times & 0.5 & \times & 0.8 & = & 244.04 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 115.77 & \times & 0.5 & \times & 0.8 & = & 249.81 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 115.77 & \times & 0.5 & \times & 0.8 & = & 244.04 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 115.77 & \times & 0.5 & \times & 0.8 & = & 249.81 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 115.77 & \times & 0.5 & \times & 0.8 & = & 237.83 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 110.22 & \times & 0.5 & \times & 0.8 & = & 237.83 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 110.22 & \times & 0.5 & \times & 0.8 & = & 237.83 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 110.22 & \times & 0.5 & \times & 0.8 & = & 237.83 & (76) \\ \hline \text{East } & 0.9x & 0.54 & \times & 11.1 & \times & 104.68 & \times & 0.5$	Water	heating	gains (1	able 5)	<u> </u>								107.0						I	(70)
Total internal gains = (66)m + (67)m + (68)m + (70)m + (71)m + (72)m (73)m= 594.84 590.62 597.53 504.48 474.8 457.39 465.44 483.96 516.46 552.62 579.97 (73) 6. Solar gains Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Table 6d Area Table 6a Flux g_ fable 6b FF Gains (W) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 42.38 (76) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 136.53 (76) East 0.9x 0.54 x 11.1 x 13.09 x 0.5 x 0.8 = 136.53 (76) East 0.9x 0.54 x 11.1 x	(72)m=	126.2	124.08	119.69	113	72 109	9.84	10	.38	99.74	105	.69	107.8	113	3.98	120.96	124	.09		(72)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Total i	nternal	gains =		1				(66)	m + (67)m	1 + (68	3)m +	- (69)m + ((70)m	1 + (1	(1)m + (72)	m		l	(70)
6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Table 6d Area m ² Flux Table 6a g_{-} FF Table 6b Table 6c (W) East $0.9x$ 0.54 x 11.1 x 19.64 x 0.5 x 0.8 $=$ 42.38 (76) East $0.9x$ 0.54 x 11.1 x 38.42 x 0.5 x 0.8 $=$ 42.38 (76) East $0.9x$ 0.54 x 11.1 x 38.42 x 0.5 x 0.8 $=$ 42.38 (76) East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 $=$ 136.53 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 $=$ 244.04 (76) x 19.3	(73)m=	594.84	590.62	569.82	537	53 504	.48	4	74.8	457.39	465	.44	483.96	516	5.46	552.62	579.	.97		(73)
Orientation:Access Factor Table 6dArea m²Flux Table 6a g_{-} Table 6bFF Table 6cGains (W)East0.9x0.54x11.1x19.64x0.5x0.8=42.38(76)East0.9x0.54x11.1x38.42x0.5x0.8=42.38(76)East0.9x0.54x11.1x63.27x0.5x0.8=82.91(76)East0.9x0.54x11.1x63.27x0.5x0.8=199.13(76)East0.9x0.54x11.1x113.09x0.5x0.8=199.13(76)East0.9x0.54x11.1x115.77x0.5x0.8=244.04(76)East0.9x0.54x11.1x115.77x0.5x0.8=249.81(76)East0.9x0.54x11.1x110.22x0.5x0.8=237.83(76)East0.9x0.54x11.1x110.22x0.5x0.8=237.83(76)East0.9x0.54x11.1x110.22x0.5x0.8=237.83(76)East0.9x0.54x11.1x <t< td=""><td>6. SO</td><td>lar gain:</td><td>S:</td><td></td><td>or flux i</td><td>rom Tobl</td><td>. 60</td><td>and</td><td>00000</td><td>atad aqua</td><td>tiona</td><td>to oo</td><td>nuart to th</td><td></td><td></td><td>ble orientet</td><td>ion</td><td></td><td></td><td></td></t<>	6. SO	lar gain:	S:		or flux i	rom Tobl	. 60	and	00000	atad aqua	tiona	to oo	nuart to th			ble orientet	ion			
Contentation:Access FactorAreaFlux g_{-} Flux g_{-} Flux g_{-} Flux g_{-}				asing soi		roo	e 0a a	anu	Elur	aleu equa	10115			e app	Jiica		1011.		Caine	
East $0.9x$ 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 42.38 (76) East $0.9x$ 0.54 x 11.1 x 38.42 x 0.5 x 0.8 = 82.91 (76) East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 = 136.53 (76) East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 = 136.53 (76) East $0.9x$ 0.54 x 11.1 x 92.28 x 0.5 x 0.8 = 199.13 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 111.1 x 94.68 x 0.5 x 0.8 = 204.3 (76)	Unerna	-	Table 6d	acioi	A	n²			Tab	x ble 6a		Т	g_ able 6b		Т	able 6c			(W)	
East $0.9x$ 0.54 x 11.1 x 38.42 x 0.5 x 0.8 = 82.91 (76) East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 = 136.53 (76) East $0.9x$ 0.54 x 11.1 x 92.28 x 0.5 x 0.8 = 199.13 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 11.1 x 94.68 x 0.5 x 0.8 = 204.3 (76)	East	0.9x	0.54)	(11.1		x [1	9.64	x		0.5	;	× [0.8		=	42.38	(76)
East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 = 136.53 (76) East $0.9x$ 0.54 x 11.1 x 92.28 x 0.5 x 0.8 = 199.13 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 11.1 x 94.68 x 0.5 x 0.8 = 204.3 (76)	East	0.9x	0.54)	(11.1		× [3	8.42	x		0.5] :	×Ē	0.8		=	82.91	(76)
East $0.9x$ 0.54 x 11.1 x 92.28 x 0.5 x 0.8 = 199.13 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 11.1 x 94.68 x 0.5 x 0.8 = 204.3 (76)	East	0.9x	0.54	;	· 🕅	11.1		× [6	3.27	x		0.5] ;	×Ē	0.8		=	136.53	(76)
East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 111.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 111.1 x 94.68 x 0.55 x 0.8 = 204.3 (76)	East	0.9x	0.54	,	·	11.1		×Ī	9	2.28	x		0.5	-	×Ē	0.8		=	199.13	(76)
East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 111.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 111.1 x 94.68 x 0.55 x 0.8 = 204.3 (76)	East	0.9x	0.54	,		11.1	Ħ	x [11	13.09	x	-	0.5	Ξ,	×Г	0.8		=	244.04	(76)
East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 11.1 x 94.68 x 0.5 x 0.8 = 237.83 (76)	East	0.9x	0.54	,		11.1	Ħ	x [11	15.77	x		0.5	٦,	×Г	0.8		=	249.81	(76)
East $0.9x$ 0.54 x 11.1 x 04.68 x 0.5 x 0.8 = 204.3 (76)	East	0.9x	0.54	,		11.1	Ħ	x [11	10.22	x		0.5	٦,	×Г	0.8	╡	=	237.83	(76)
	East	0.9x	0.54	,		11.1	Ē	× [9.	4.68	x		0.5	: ۲	×Ē	0.8		=	204.3	(76)

East	0.9x	0.54	×	11.1	x	73.59	x	0.5	×	0.8	=	158.79	(76)
East	0.9x	0.54	×	11.1	×	45.59] × [0.5	×	0.8	=	98.37	(76)
East	0.9x	0.54	×	11.1	x	24.49	×	0.5	×	0.8	=	52.84	(76)
East	0.9x	0.54	×	11.1	×	16.15) × [0.5	×	0.8	=	34.85	(76)
West	0.9x	0.77	×	5.6	×	19.64] × [0.5	×	0.8	=	30.49	(80)
West	0.9x	0.77	×	5.6	×	38.42] × [0.5	×	0.8	=	59.64	(80)
West	0.9x	0.77	x	5.6	×	63.27] × [0.5	×	0.8	=	98.22	(80)
West	0.9x	0.77	×	5.6	×	92.28] × [0.5	×	0.8	=	143.25	(80)
West	0.9x	0.77	×	5.6	×	113.09] × [0.5	×	0.8	=	175.56	(80)
West	0.9x	0.77	×	5.6	×	115.77] × [0.5	×	0.8	=	179.71	(80)
West	0.9x	0.77	×	5.6	×	110.22] × [0.5	×	0.8	=	171.09	(80)
West	0.9x	0.77	x	5.6	×	94.68] × [0.5	×	0.8	=	146.97	(80)
West	0.9x	0.77	x	5.6	×	73.59) × [0.5	×	0.8	=	114.23	(80)
West	0.9x	0.77	x	5.6	x	45.59	×	0.5	×	0.8	=	70.77	(80)
West	0.9x	0.77	x	5.6	x	24.49	x	0.5	x	0.8	=	38.01	(80)
West	0.9x	0.77	×	5.6	x	16.15	x	0.5	×	0.8	=	25.07	(80)
Solar	gains in	watts, calcu	lated	for each mon	th		(83)m =	Sum(74)m	. <mark>(8</mark> 2)m			1	
(83)m=	72.87	142.55 23	4.75	342.37 419.5	9 4	29.53 408.93	351.26	273.03	169.14	4 90.86	59.92		(83)
Total	gains – ii	nternal and	solar	(84)m = (73)n	1 + (83)m , watts				_			(5.1)
(84)m=	667.71	733.17 80	4.58	879.9 924.0	7 9	04.33 866.32	816.7	756.99	685.6	643.48	639.89		(84)
7. Me	ean <mark>inter</mark>	nal tempera	ature (heating sease	on)								
7. Me Tem	ean inter perature	nal tempera during heat	ature (ting pe	heating seaso eriods in the li	on) ving	area from Ta	ble 9, T	⁻ h1 (°C)				21	(85)
7. Me Tem Utilis	ean inter perature ation fac	nal tempera during heat tor for gains	ature (ting pe s for li	heating seaso eriods in the li ving area, h1,	on) ving m (s	area from Ta ee Table 9a)	ble 9, T	⁻ h1 (°C)				21	(85)
7. Me Tem Utilis	ean inter perature ation fac Jan	nal tempera during heat tor for gains Feb	ature (ting pa s for li Mar	heating seaso eriods in the li ving area, h1, Apr Ma	on) ving m (s	area from Ta ee Table 9a) Jun Jul	ble 9, T Aug	h1 (°C)	Oct	Nov	Dec	21	(85)
7. Me Tem Utilis (86)m=	ean inter perature ation fac Jan 0.83	nal tempera during heat stor for gains Feb f 0.77 0	ature (ting pe s for li Mar .67	heating seaso eriods in the li ving area, h1, Apr Ma 0.53 0.4	on) ving m (s	area from Ta ee Table 9a) Jun Jul 0.28 0.2	ble 9, T Aug 0.22	Th1 (°C) Sep 0.36	Oct 0.58	Nov 0.76	Dec 0.84	21	(85)
7. Ma Temp Utilis (86)m= Mear	ean inter perature ation fac Jan 0.83	nal tempera during heat tor for gains Feb I 0.77 0 I temperatu	ture (ting pe s for li Mar .67 re in li	heating seaso priods in the li ving area, h1, Apr May 0.53 0.4 iving area T1	on) ving m (s y (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to	ble 9, T Aug 0.22 7 in Tal	Th1 (°C) g Sep 0.36 ole 9c)	Oct 0.58	Nov 0.76	Dec 0.84	21	(85)
7. Ma Tem Utilis (86)m= Mear (87)m=	ean inter perature ation fac Jan 0.83 n interna 20.63	nal tempera during heat stor for gains Feb I 0.77 0 I temperatur 20.74 20	ture (ing po s for li Mar .67 re in li 0.87	heating seaso eriods in the living area, h1, Apr May 0.53 0.4 iving area T1 20.96 20.99	on) ving m (s y (follo	area from Taee Table 9a)JunJul0.280.2ow steps 3 to2121	ble 9, T Aug 0.22 7 in Tal 21	Th1 (°C) J Sep 0.36 0.36 ole 9c) 21	Oct 0.58 20.95	Nov 0.76	Dec 0.84 20.59	21	(85) (86) (87)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp	ean inter perature ation fac Jan 0.83 n interna 20.63 perature	nal tempera during heat stor for gains Feb I 0.77 0 I temperatu 20.74 20 during heat	iture (ting pe s for li Mar 67 re in li 0.87	heating seaso eriods in the living area, h1, Apr May 0.53 0.4 iving area T1 20.96 20.99 eriods in rest o	on) ving m (s y (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta	ble 9, T Aug 0.22 7 in Tal 21 able 9,	Th1 (°C) Sep 0.36 ble 9c) 21 Th2 (°C)	Oct 0.58 20.95	Nov 0.76 20.79	Dec 0.84 20.59	21	(85) (86) (87)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5	nal temperativeduring heatctor for gainsFeb0.7701 temperature20.7420.7420.52	iture (ting pe s for li Mar .67 re in li 0.87 ting pe 0.5	heating seaseeriods in the lingving area, h1,AprAprMay0.530.4iving area20.9620.96eriods in rest of20.5120.51	on) ving m (s v (follo of dw	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta 20.51 20.51	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51	Th1 (°C) 9 Sep 0.36 oble 9c) 21 Th2 (°C) 20.51	Oct 0.58 20.95 20.51	Nov 0.76 20.79 20.51	Dec 0.84 20.59 20.5	21	(85) (86) (87) (88)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac	nal temperationduring heatctor for gainsFebI0.770I temperature20.7420during heat20.52ctor for gains	iture (ing pe s for li Mar .67 re in li 0.87 ting pe 0.5 s for re	heating seaso eriods in the living area, h1, Apr May 0.53 0.4 iving area T1 20.96 20.99 eriods in rest of 20.51 20.51 est of dwelling	n) ving m (s / (follc (follc	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta 20.51 20.51 ,m (see Table	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 29a)	Th1 (°C) Sep 0.36 ole 9c) 21 Th2 (°C) 20.51	Oct 0.58 20.95 20.51	Nov 0.76 20.79 20.51	Dec 0.84 20.59 20.5	21 	(85) (86) (87) (88)
7. Ma Temp Utilis (86)m= Mear (87)m= Temp (88)m= Utilis (89)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81	nal temperativeduring heatctor for gainsFeb0.770.771 temperatur20.7420.7420.52ctor for gains0.750	ture (ting pe s for li Mar .67 re in li 0.87 ting pe 0.5 s for re	heating seaseeriods in the lingving area, h1,AprMay0.530.4iving areaT120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38	ving m (s y (follc j, h2	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta 20.51 20.51 ,m (see Table 0.26 0.18	ble 9, 7 Aug 0.22 7 in Tal 21 able 9, 20.51 9a) 0.2	Th1 (°C) 9 Sep 0.36 ole 9c) 21 Th2 (°C) 20.51	Oct 0.58 20.95 20.51	Nov 0.76 20.79 20.51	Dec 0.84 20.59 20.5	21]]	(85) (86) (87) (88) (88)
7. Ma Temp Utilis (86)m= Meau (87)m= Temp (88)m= Utilis (89)m= Meau	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81	nal temperative during heat ctor for gains Feb I 0.77 0 I temperature 20 during heat 20 during heat 20 ctor for gains 0 0.75 0	iture (ing pe s for li Mar .67 re in li 0.87 ting pe 0.5 s for re .66	heating seaseeriods in the living area, h1,AprMay0.530.4iving area T120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwell	y (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta 20.51 20.51 ,m (see Table 0.26 0.18	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 9 9a) 0.2 0.2	Th1 (°C) 9 Sep 0.36 ole 9c) 21 Th2 (°C) 20.51 0.33 0.7 in Table	Oct 0.58 20.95 20.51 0.56	Nov 0.76 20.79 20.51 0.74	Dec 0.84 20.59 20.5 0.83	21 	(85) (86) (87) (88) (89)
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7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m= Mean (92)m= Apply (93)m=	an inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20 n interna 20.36 y adjustn 20.36	nal temperation during heat ctor for gains Feb I 0.77 0 I temperature 20 20.74 20 during heat 20 20.74 20 during heat 20 20.75 0 temperature 20 0.75 0 I temperature 20 1 temperature 20 1 temperature 20 20.16 20 1 temperature 20 20.49 20	iture (ing person s for li Mar .67 re in li 0.87 ing person 0.5 s for re .66 re in t 0.33 re (for 0.64 mean 0.64	heating seaseeriods in the living area, h1,AprMay0.530.4iving area T120.9620.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwell20.4520.5the whole dw20.7520.78internal temp20.7520.78	ving m (s (follo) (follo) (follo)) (follo)) (follo)) (follo)) (follo)) (follo)) (follo))) (follo))) (follo)))) (follo)))) (follo))))) (follo)))))) (follo)))))) (follo)))))) (follo)))))) (follo)))))) (follo)))))))) (follo))))))) (follo))))))))) (follo)))))) (follo))))) (follo))))))) (follo)))))) (follo)))) (follo)))) (follo)))) (follo)))) (follo)))) (follo)))) (follo)) (follo))	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta 20.51 20.51 velling from Ta 0.26 0.18 0.26 0.18 0.26 0.18 1 T2 (follow str 20.51 20.51 20.51 20.51 are from Table 20.79 20.79	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 99a) 0.2 eps 3 to 20.51 + (1 – 20.8 + (20.8)	Th1 (°C) Sep 0.36 0.36 0.36 0.36 21 Th2 (°C) 20.51 0.33 07 in Table 20.51 fLA) × T2 20.79 here appro 20.79	Oct 0.58 20.95 20.51 0.56 20.45 20.45 A = Liv 20.74 priate 20.74	Nov 0.76 20.79 20.51 0.74 20.24 zing area ÷ (2 20.56	Dec 0.84 20.59 20.5 0.83 19.96 4) = 20.33	21 21 0.58	(85) (86) (87) (88) (89) (90) (91) (92) (93)
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7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m= Mean (90)m= Mean (92)m= Apply (93)m= 8. Sp Set T	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20 n interna 20.36 y adjustn 20.36 y adjustn 20.36	nal temperation during heat ctor for gains Feb I 0.77 0 I temperature 20 20.74 20 during heat 20 during heat 20 ctor for gains 0.75 0.75 0 I temperature 20.16 20.16 20 I temperature 20.49 20.49 20 nent to the r 20.49 20.49 20 mean intern 20.49	iture (ing pe s for li Mar .67 re in li 0.87 .66 s for re .66 re in t 0.33 re (for 0.64 mean 0.64 mean 0.64 mean 0.64	heating seaseeriods in the living area, h1,AprMay0.530.4iving area T120.9620.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwelling20.4520.5the whole dw20.7520.78internal tempo20.7520.78	innec	area from Taarea Table 9a)JunJul0.280.2ow steps 3 to2121velling from Ta20.5120.51velling from Ta20.5120.51on (see Table0.260.180.260.180.260.180.27120.5120.5120.5120.5120.79ure from Table20.7920.79ure from Table20.7920.79d at step 11 of	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 e 9a) 0.2 eps 3 to 20.51 + (1 – 20.8 e 4e, wl 20.8 e 4e, wl 20.8	Th1 (°C) J Sep 0.36 ole 9c) 21 Th2 (°C) 20.51 0.33 0 7 in Table 20.51 fLA) × T2 20.79 nere appro 20.79 9b, so that	Oct 0.58 20.95 20.51 0.56 e 9c) 20.45 20.45 20.74 priate 20.74 priate 20.74	Nov 0.76 20.79 20.51 0.74 20.24 ring area ÷ (4 20.56 20.56 20.56	Dec 0.84 20.59 20.5 0.83 19.96 4) = 20.33 20.33 20.33	21 21	(85) (86) (87) (88) (89) (90) (91) (92) (93)
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Utilisation factor for gains, hm:						
(94)m= 0.81 0.75 0.66 0.52 0.39 0.27 0.19 0.21	0.35	0.57	0.74	0.83		(94)
Useful gains, hmGm , W = (94)m x (84)m						
(95)m= 540.92 553.11 531.08 461.17 359.97 244.46 165.79 173.3	264.26	389.56	477.82	529.03		(95)
Monthly average external temperature from Table 8	,			1	l	(22)
(96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm, $V = [(39) \text{ m X} [(93) \text{ m} - 653.04 632.59 572.42 474.44 362.99 244.88 165.86 173.4$	- (96)m 265.64	405.16	540 27	650 13		(97)
Space beating requirement for each month $kWh/month = 0.024 \times [(97)]$	m = (95)	ml x (4')	1)m	030.13		(01)
(98)m= 83.42 53.41 30.76 9.56 2.25 0 0 0		11.6	44.97	90.1		
Tota	l per year ((kWh/year) = Sum(9	8)15,912 =	326.06	(98)
Space heating requirement in kWh/m²/year					4.2	(99)
9b. Energy requirements – Community heating scheme						_1
This part is used for space heating, space cooling or water heating prov	vided by a	a comm	unity scł	neme.		
Fraction of space heat from secondary/supplementary heating (Table 1	1) '0' if no	one	•		0	(301)
Fraction of space heat from community system $1 - (301) =$					1	(302)
The community scheme may obtain heat from several sources. The procedure allows for	CHP and u	ip to four o	other heat	sources; ti	he latter	_
includes boilers, heat pumps, geothermal and waste heat from power stations. See Apper Fraction of heat from Community boilers	ndix C.				1	7(303a)
Fraction of total space heat from Community boilers		(3)	02) v (303	a) –	1	(304a)
Easter for control and charging method (Table $4c(2)$) for community has	ting over		02) X (000	a) –	1	
Pietribution loss factor (Table 12a) for community heating system	anng syst	em			1	
Distribution loss factor (Table 12c) for community neating system					1.15	(306)
Space heating Annual space heating requirement					326.06]
Space heat from Community boilers	(98) x (30	4a) x (30	5) x (306)	=	374.97	(307a)
Efficiency of secondary/supplementary heating system in % (from Table	e 4a or Aj	ppendix	E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (30	01) x 100 ÷	+ (308) =		0	(309)
Water heating						-
Annual water heating requirement					2091.65	
If DHW from community scheme: Water heat from Community boilers	(64) x (30	3a) x (308	5) x (306) :	=	2405.4	(310a)
Electricity used for heat distribution 0.01	× [(307a).	(307e) +	(310a)((310e)] =	27.8	(313)
Cooling System Energy Efficiency Ratio					0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷	(314) =			0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside					250.5	(330a)
warm air heating system fans					0	(330b)
pump for solar water heating					0	(330g)
Total electricity for the above, kWh/year	=(330a) +	- (330b) +	(330g) =		250.5	_ (331)
• • •						ц́

Energy for lighting (calculated in Appen	dix L)		342.54 (332)
10b. Fuel costs – Community heating	scheme		
	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating from CHP	(307a) x	4.24 × 0.0	1 = 15.9 (340a)
Water heating from CHP	(310a) x	4.24 × 0.0	1 = <u>101.99</u> (342a)
		Fuel Price	
Pumps and fans	(331)	13.19 × 0.0	1 = 33.04 (349)
Energy for lighting	(332)	13.19 × 0.0	1 = 45.18 (350)
Additional standing charges (Table 12)			120 (351)
Total energy cost	= (340a)(342e) + (345)(354) =		316.11 (355)
11b. SAP rating - Community heating	scheme		
Energy cost deflator (Table 12)			0.42 (356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =		1.08 (357)
SAP rating (section12)			84.89 (358)
12b. CO2 Emissions - Community hea	ting scheme		
	Ene	rgy Emission fact	tor Emissions
	water beating (net CUD)	ryear ky CO2/kwi	kg CO2/year
Efficiency of heat source 1 (%)	If there is CHP using two fuels	repeat (363) to (366) for the second	1 fuel 89.5 (367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 1	00 ÷ (367b) x 0.22	= 671.02 (367)
Electrical energy for heat distribution	[(313) x	0.52	= 14.43 (372)
Total CO2 associated with community s	systems (363)(36	6) + (368)(372)	= 685.45 (373)
CO2 associated with space heating (se	condary) (309) x	0	= 0 (374)
CO2 associated with water from immer	sion heater or instantaneous hea	ter (312) x 0.22	= 0 (375)
Total CO2 associated with space and w	vater heating (373) + (37	74) + (375) =	685.45 (376)
CO2 associated with electricity for pum	ps and fans within dwelling (331))) x 0.52	= 130.01 (378)
CO2 associated with electricity for light	ng (332))) x	0.52	= 177.78 (379)
Total CO2, kg/year	sum of (376)(382) =		993.24 (383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =		12.8 (384)
El rating (section 14)			89.14 (385)
13b. Primary Energy – Community hea	ting scheme		
	Ene kWł	rgy Primary n/year factor	P.Energy kWh/year
Energy from other sources of space an Efficiency of heat source 1 (%)	d water heating (not CHP) If there is CHP using two fuels	repeat (363) to (366) for the second	l fuel 89.5 (367a)
Energy associated with heat source 1	[(307b)+(310b)] x 1	00 ÷ (367b) x 1.22	= 3790 (367)
Electrical energy for heat distribution	[(313) x	、 , <u></u>	= 85.36 (372)
	[(010) ×		05.50 (572)

Total Energy associated with community systems	(363)(366) + (368)(372)		=	3875.36	(373)
if it is negative set (373) to zero (unless specified otherwise,	see C7 in Appendix C)			3875.36	(373)
Energy associated with space heating (secondary)	(309) x	0	=	0	(374)
Energy associated with water from immersion heater or instan	taneous heater(312) x	1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =			3875.36	(376)
Energy associated with space cooling	(315) x	3.07	=	0	(377)
Energy associated with electricity for pumps and fans within de	welling (331)) x	3.07	=	769.04	(378)
Energy associated with electricity for lighting	(332))) x	3.07	=	1051.61	(379)
Total Primary Energy, kWh/year sum of (376)	(382) =			5696	(383)



		Use	er Details:						
Assessor Name: Software Name:	Stroma FSAP 2012	2	Stroma Softwa	a Numi ire Ver	ber: sion:		Versio	n: 1.0.4.18	
		Prope	erty Address:	11_s_m	1				
Address :	Block I, Agar Grove,	Camden, Lo	ondon, NW1	9TB					
1. Overall dwelling dime	ensions:		(m ²)			iaht(m)		Volumo(m ³)	
Ground floor			77.6	(1a) x	АV. Пе	.15	(2a) =	244.44	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)	+(1n)	77.6	(4)					
Dwelling volume				(3a)+(3b)	+(3c)+(3d	l)+(3e)+	.(3n) =	244.44	(5)
2. Ventilation rate:	·								
	main se heating he	condary eating	other		total			m ³ per hour	•
Number of chimneys	0 +	0 +	0] = [0	x 4	= 0	0	(6a)
Number of open flues	0 +	0 +	0] = [0	x 2	20 =	0	(6b)
Number of intermittent fa	ns			, r	0	x 1	0 =	0	(7a)
Number of passive vents	i				0	x 1	0 =	0	(7b)
Number of flueless gas fi	res				0	× 4	40 =	0	(7c)
							Air ch	ange <mark>s per</mark> ho	ur
Infiltration due to chimne	ys, flues and fans = (6a)+(6b)+(7a)+(7	/b)+(7c) = 17) otherwise c	ontinue fro	0	(16)	÷ (5) =	0	(8)
Number of storeys in the	ne dwelling (ns)	a, proceed to (, (o) to (10)	[0	(9)
Additional infiltration						[(9)-	1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber fi	rame or 0.35	5 for masonr	y constr	uction			0	(11)
if both types of wall are pl	resent, use the value corresp	onding to the g	greater wall area	a (after					
If suspended wooden f	iloor. enter 0.2 (unseale	ed) or 0.1 (se	ealed), else	enter 0			[0	T (12)
If no draught lobby, en	ter 0.05, else enter 0	, (,,					0	(13)
Percentage of windows	s and doors draught str	ipped						0	(14)
Window infiltration			0.25 - [0.2	x (14) ÷ 1	= [00			0	(15)
Infiltration rate			(8) + (10) -	+ (11) + (1	2) + (13) +	+ (15) =		0	(16)
Air permeability value,	q50, expressed in cubi	c metres pe	r hour per so	quare me	etre of e	nvelope	area	1	(17)
If based on air permeabil	ity value, then $(18) = [(17)]$	') ÷ 20]+(8), oth	nerwise (18) = (16)				0.05	(18)
Air permeability value applie	es if a pressurisation test has	been done or a	a degree air per	meability i	s being us	sed	r		
Shelter factor	iu		(20) = 1 - [0.075 x (1	9)] =			0.85	(19)
Infiltration rate incorporat	ing shelter factor		(21) = (18)	x (20) =			l	0.03	(20)
Infiltration rate modified f	or monthly wind speed						l	0.04	
Jan Feb	Mar Apr May	Jun Ju	ul Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	eed from Table 7	•							
(22)m= 5.1 5	4.9 4.4 4.3	3.8 3.	8 3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (22	2)m ÷ 4			I					
(22a)m= 1.27 1.25	1.23 <u>1.1</u> 1.08	0.95 0.9	95 0.92	1	1.08	1.12	1.18		

Adjust	ed infiltr	ation rate	e (allowi	ing for sh	nelter an	d wind s	peed) =	(21a) x	(22a)m					
_	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.05		
Calcul	ate effe	ctive air	change	rate for t	he appli	cable ca	se		-		-	-	-	
IT ME	ecnanica		tion:	" N (0		、 - (. (00)				0.5	(23a)
If exh	aust air h	eat pump (using App	endix N, (2	(23a) = (23a	i) × Fmv (e	equation (P	N5)), othe	rwise (23b) = (23a)			0.5	(23b)
lf bala	anced with	heat reco	overy: effic	ciency in %	allowing f	or in-use f	actor (from	n Table 4h) =				76.5	(23c)
a) If	balance	ed mecha	anical ve	entilation	with hea	at recove	ery (MVI	HR) (24a	a)m = (22	2b)m + (1	23b) × [1 – (23c)) ÷ 100]	
(24a)m=	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17		(24a)
b) If	balance	ed mecha	anical ve	entilation	without	heat rec	overy (N	ИV) (24b)m = (22	2b)m + (2	23b)	-	_	
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If	whole h	ouse ex	tract ver	ntilation o	or positiv	e input v	ventilatio	on from c	outside					
i	if (22b)n	n < 0.5 ×	: (23b), t	then (24	c) = (23b); otherv	wise (24	c) = (22b	o) m + 0.	5 × (23b)			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If	natural	ventilatio	on or wh	ole hous	se positiv	ve input	ventilatio	on from I	oft					
i	if (22b)n	n = 1, the	en (24d))m = (22b T	o)m othe	erwise (2	4d)m = 0	0.5 + [(2	2b)m² x	0.5]			1	<i>(</i> - -)
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effe	ctive air	change	rate - er	nter (24a) or (24t	o) or (24	c) or (24	d) in boy	k (25)				•	
(25)m=	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17		(25)
3. He	at losse	s and he	at loss i	paramete	er:									_
		Gros	s	Openin	as	Net Ar	ea	U-valı	ue	AXU		k-valu	e A	A X k
		area	(m²)	m	12	A ,r	n²	W/m2	2K	(W/I	K)	kJ/m ² ·	K I	J/K
Windo	ws Type	e 1				5.6	×1/	[1/(0.85)+	+ 0.04] =	4.6				(27)
Windo	ws Type	2				11.1	x1/	[1/(0.85)+	+ 0.04] =	9.12				(27)
Walls ⁻	Type1	38.4	4	11.1		27.3	x	0.2	i - T	5.46	Fir			(29)
Walls ⁻	Tvpe2	8.5		5.6		29		0.2		0.58				(29)
Total a	irea of e		m²			46.0		0.2	[0.00	L			(31)
* for win	dows and	roof winde	, ows. use e	effective wi	ndow U-va	alue calcul	ated usino	i formula 1	/I(1/U-valu	ie)+0.041 a	as aiven in	paragrap	132	(01)
** inclua	le the area	as on both	sides of ir	nternal wal	ls and part	titions	atou aonig	, ionnaid i	//(<i>ii</i> /c ⁻ /aia	<i></i>	ie gireir ii	pulugiupi		
Fabric	heat los	s, W/K =	= S (A x	U)				(26)(30)) + (32) =				19.77	(33)
Heat c	apacity	Cm = S(Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	513.4	(34)
Therm	al mass	parame	ter (TMI	P = Cm ÷	- TFA) ir	n kJ/m²K			Indica	tive Value	: Low		100	(35)
For desi	gn assess	sments wh	ere the de	etails of the	construct	ion are not	t known pr	ecisely the	e indicative	values of	TMP in T	able 1f		
can be ι	ised inste	ad of a dei	tailed calc	ulation.										
Therm	al bridg	es : S (L	x Y) cal	culated u	using Ap	pendix ł	<						7.04	(36)
if details	of therma	al bridging	are not kr	10wn (36) =	= 0.05 x (3	1)			(00)	(00)				
	abric ne	at loss							(33) +	(36) =			26.8	(37)
Ventila	ition hea	at loss ca	alculated	d monthly	y I		I	1	(38)m	= 0.33 × (25)m x (5) I)	1	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	13.85	13.76	13.68	13.25	13.16	12.74	12.74	12.65	12.91	13.16	13.33	13.51	J	(38)
Heat tr	ansfer o	coefficier	nt, W/K						(39)m	= (37) + (3	38)m		_	
(39)m=	40.65	40.57	40.48	40.05	39.97	39.54	39.54	39.45	39.71	39.97	40.14	40.31		
										Average =	Sum(39)	12 /12=	40.03	(39)
Heat lo	oss para	Imeter (H	HLP), W	/m²K	-			<u> </u>	(40)m	= (39)m ÷	· (4)	<u> </u>	1	
(40)m=	0.52	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.51	0.52	0.52	0.52		(
									/	Average =	Sum(40)1	₁₂ /12=	0.52	(40)

Numbe	er of day	rs in moi	nth (Tab	le 1a)			-			-	-	-		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Wa	ater heat	ing enei	rgy requ	irement:								kWh/ye	ear:	
Assum if TF if TF	ned occu A > 13.9 A £ 13.9	ipancy, l 9, N = 1 9, N = 1	N + 1.76 x	[1 - exp	(-0.0003	349 x (TF	⁻ A -13.9)2)] + 0.(0013 x (⁻	TFA -13.	<u>2</u> . 9)	42]	(42)
Annua Reduce not more	l averag the annua e that 125	e hot wa Il average litres per l	ater usag hot water person pel	ge in litre usage by r dav (all w	es per da 5% if the d ater use. I	ay Vd,av Iwelling is not and co	erage = designed i ld)	(25 x N) to achieve	+ 36 a water us	se target o	91 f	.57]	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Αυσ	Sen	Oct	Nov	Dec]	
Hot wat	er usage in	n litres per	day for ea	ach month	Vd,m = factor	ctor from T	Table 1c x	(43)	000	000	1107	200	l	
(44)m=	100.73	97.07	93.41	89.74	86.08	82.42	82.42	86.08	89.74	93.41	97.07	100.73		_
Energy	content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,n	n x nm x D)))))))))))))))))))	-) kWh/mor	Total = Su oth (see Ta	m(44) ₁₁₂ = ables 1b, 1	= c, 1d)	1098.89	(44)
(45)m=	149.38	130.65	134.82	117.54	112.78	97.32	90.18	103.49	104.72	122.04	133.22	144.67		
				1					-	Total = Su	m(45) ₁₁₂ =		1440.81	(45)
lf instan	taneous w	ater heatil	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46) to (61)					
<mark>(46)</mark> m= Water	22.41	19.6	20.22	17.63	16.92	14.6	13.53	15.52	15.71	18.31	19.98	21.7		(46)
Storag	e volum	e (litre <mark>s</mark>)	includir	ng any so	olar or W	WHRS	storage	within sa	ame ves	sel		0		(47)
lf co <mark>m</mark> Otherv Water	munity h vise if no storage	eating a stored loss:	ind no ta hot wate	ink in dw er (this ir	velling, e ncludes i	nter 110 nstantar) litres in neous co	(47) ombi boil	ers) ente	er '0' in (47)			
a) I <mark>f m</mark>	nanufact	urer's de	eclared I	oss facto	or is kno	wn (kWr	n/day):					0		(48)
Tempe	erature fa	actor fro	m Table	2b								0		(49)
Energy	y lost fro	m water	storage	, kWh/ye	ear	or is not	known:	(48) x (49)) =		1	10]	(50)
Hot wa	ater stora munity h	age loss eating s	factor fr	om Tabl	e 2 (kWl	h/litre/da	ay)				0.	02]	(51)
Volum	e factor	from Ta	ble 2a								1.	03		(52)
Tempe	erature fa	actor fro	m Table	2b							0	.6		(53)
Energy	lost fro	m water	storage	e, kWh/ye	ear			(47) x (51)	x (52) x (53) =	1.	03		(54)
Water	storage	loss cal	culated	for each	month			((56)m = (55) × (41)ı	m	1.	03		(55)
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01]	(56)
If cylinde	er contains	dedicate	d solar sto	l rage, (57)	m = (56)m	x [(50) – (I H11)] ÷ (5	0), else (5	7)m = (56)	m where (L H11) is fro	m Append	l lix H	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(57)
Primar	y circuit	loss (ar	Inual) fro	om Table	e 3							0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m cylinde	r thermo	stat)			
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss cal	culated	for each	month ((61)m =	(60) ÷ 36	65 × (41)m		1	1		I	
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0]	(61)

(e2)m 20.4 68 190.5 171.0.3 190.08 150.82 145.46 158.72 178.22 177.22 188.71 198.84 (e2) Stati DHW nput calculated using Appendix G or Appendix H (regative quantity) (rentry U in o solar cambulanto to water heating) (add additional lines if FGHRS applies, see Appendix G) Using the solar cambulanto to water heating) (e3)m 0 </th <th>Total h</th> <th>leat req</th> <th>uired for</th> <th>water h</th> <th>neatin</th> <th>g calc</th> <th>ulated</th> <th>l fo</th> <th>r each</th> <th>n month</th> <th>(62)</th> <th>m =</th> <th>0.85 × (</th> <th>45)m</th> <th>+ (</th> <th>46)m +</th> <th>(57)r</th> <th>n +</th> <th>(59)m + (61)m</th> <th></th>	Total h	leat req	uired for	water h	neatin	g calc	ulated	l fo	r each	n month	(62)	m =	0.85 × (45)m	+ (46)m +	(57)r	n +	(59)m + (61)m	
Salar CMV input actualized using Appendix H meganity (emery V in a salar contribution to water heating) (add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (63) Output from water heater (64)m 20.66 180.58 180.1 171.03 168.06 150.82 145.46 158.76 158.22 177.32 186.71 199.94 (64)m 20.66 180.58 180.1 171.03 168.06 150.82 145.46 158.76 158.22 177.52 186.71 199.94 (64)m 20.66 180.58 180.1 171.03 168.06 150.82 145.46 158.76 158.22 177.52 186.71 199.94 (64)m 20.66 180.58 180.1 171.03 168.06 150.82 145.46 158.76 158.22 177.52 186.71 199.94 (65)m 20.88 83.88 80.05 81.88 81.72 76.15 74.21 78.63 77.62 84.8 87.09 92.32 (65) Include (57)m in calculation of (65)m only if cylinder is in the dwalling or hot water is from community heating 5. Internal quite Scee Table 5 and 5.5 : Wetabolic gains (Table 5), Watts (68)m 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 (65) (17)m 484.8 43.07 35.03 26.52 188.8 16.73 18.08 22.63 31.55 40.88 46.75 40.84 (65) (17)m 484.8 43.07 35.03 26.52 188.8 16.73 18.08 22.63 31.55 40.88 46.75 40.84 (67) Appliances gains (calculated in Appendix L, equation L15 or L1530 / also see Table 5 (67)m 484.8 43.07 35.03 26.52 188.8 16.73 18.08 22.64 31.55 40.88 46.75 40.84 (67) Appliances gains (calculated in Appendix L, equation L15 or L1530 / also see Table 5 (67)m 484.8 43.07 35.03 26.52 188.8 10.15 0 / L1530 / also see Table 5 (69)m 51.91 51.9	(62)m=	204.66	180.58	190.1	171	.03 1	68.06	15	50.82	145.46	158	.76	158.22	177.3	32	186.71	199.	94		(62)
(add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (a) 0	Solar DI	-IW input	calculated	using Ap	pendix	G or Ap	ppendix	н (negativ	ve quantity) (ent	er '0'	if no solar	r contri	butio	on to wate	r heat	ing)		
	(add a	dditiona	I lines if	FGHR	S and	or WV	NHRS	ap	plies,	, see Ap	pend	lix G	3)							
Output from water heater (64)m 204.86 180.58 190.1 171.03 186.06 150.82 145.46 158.62 177.32 186.71 199.94 Upput from water heating, kWh/month 0.25 10.85 × (45)m + (61)m) + 0.8 × [(46)m + (67)m + (59)m] 2091.65 (64) (69)m 93.88 83.38 93.05 81.88 81.72 75.15 74.21 78.63 77.62 84.8 87.09 92.32 (65) Include (57)m in calculation of (65) mony if cylinder is in the dwelling or hot water is from community heating 5. Include (57)m in calculation of (65) mony if cylinder is in the dwelling or hot water is from community heating 660m 144.94 144.9	(63)m=	0	0	0	C		0		0	0	0		0	0		0	0			(63)
(e4)me 204.66 180.58 190.1 171.03 180.06 150.82 145.46 158.76 158.22 177.32 186.71 199.94 0.000 trom water heating. kWh/month 0.25 ' (0.85 × (45)m + (61)m) + 0.8 × ((46)m + (57)m + (57)m + (59)m) (64) 93.89 93.38 90.05 81.88 81.72 75.15 74.21 78.63 77.62 64.8 77.72<	Output	from w	ater hea	ter																
Undput from water heating, kWh/month 0.25 (0.85 x (45)m + (61)m) + 0.8 x [(46)m + (57)m + (59)m] (64) (65)m 93.89 83.38 89.05 81.88 81.72 75.15 74.21 78.63 77.62 84.8 87.09 92.32 (65) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from comunity heating 5.	(64)m=	204.66	180.58	190.1	171	.03 1	68.06	15	50.82	145.46	158	.76	158.22	177.:	32	186.71	199.	94		_
Heat gains from water heating, kWh/month 0.25 ¹ [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] (65)m 9 8.89 8.38 8.05 81.88 81.72 75.15 74.21 78.63 77.62 84.8 87.09 82.32 (65) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Internal gains (cee Table 5 and 53) : Metabolic gains (Table 5), Wats (66)m 1 141.94 144.94 149.94 1			-									Outp	out from wa	ater he	ater	(annual) _{1.}	12		2091.65	(64)
(66)me 93.89 83.38 89.05 81.88 81.72 75.15 74.21 78.63 77.62 84.8 87.09 92.32 (65) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Total agins (see Table 5 and 5a): Water Main Apr May Jun Jul Aug Sep Oct Nov Dec (66) (66)me 144.94<	Heat g	ains fro	m water	heating	, kWI	n/mon ⁻	th 0.2	5 ´	[0.85	× (45)m	+ (6	1)m] + 0.8 x	(46))m -	⊦ (57)m	+ (59	9)m]	
Include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Internal gains (caee Table 5). Watts Metabolic gains (Table 5). Watts (66) 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 (66) Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (67)m 49.49 43.07 35.03 28.52 19.82 16.73 18.08 23.5 31.55 49.06 46.75 49.84 Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68)m 91.93 323.28 314.88 29.07 274.59 25.04 29.34 296.02 244.39 26.22 284.88 305.81 Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)m 91.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 Pumps and fans gains (Table 5a) (70)m 90 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(65)m=	93.89	83.38	89.05	81.	88 8	81.72	7	5.15	74.21	78.	63	77.62	84.8	3	87.09	92.3	32		(65)
5. Internal gains (see Table 5). Watts Jan Feb Mar Apr May Jun Jun Aug Sep Oct Nov Dec (66)m= 144.94 1	inclu	ide (57)	m in calo	culation	of (6	5)m or	nly if c	ylir	nder is	s in the c	dwell	ing	or hot wa	ater is	s fro	om comi	muni	ty h	eating	
$ \begin{array}{ccccc} detabolic qains (Table 5), Watts \\ \mbox{detabolic qains (Calculated in Appendix L, equation L9 or L9a), also see Table 5 \\ \mbox{detabolic qains (Calculated in Appendix L, equation L13 or L13a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L13 or L13a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L13 or L13a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L15 or L15a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L15 or L15a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L15 or L15a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L15 or L15a), also see Table 5 \\ \mbox{detabolic qains (Table 5a) \\ \mbox{detabolic qains (Table 5b) \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to th$	5. Int	ternal g	ains (see	Table	5 and	5a):														
$ \begin{array}{ c c c c c c } \hline \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Metab	olic gair	ns (Table	5) Wa	tte	,														
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	motab	Jan	Feb	Mar	A	or	May		Jun	Jul	A	ug	Sep	Oc	rt	Nov	De	эс		
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (67) m 48.49 43.07 35.03 26.52 19.82 16.73 18.08 23.5 31.55 40.06 46.75 49.84 (67) Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68) m 319.93 323.25 314.88 297.07 274.59 253.46 239.34 230.02 244.39 26.22 284.68 305.81 (68) Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69) m 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 (70) m 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(66)m=	144.94	144.94	144.94	144	.94 1	44.94	14	14.94	144.94	144	.94	144.94	144.9	94	144.94	144.	94		(66)
	Liahtin	a aains	(calcula	ted in A	neda	dix L.	equat	ion	L9 or	r L9a), a	lso s	ee T	Lable 5							
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68) = $319.33 323.25 314.88 297.07 274.59 253.46 239.34 236.02 244.39 262.2 284.68 305.81 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 (69) = 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91(69) Pumps and fans gains (Table 5a)(70) • 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0$	(67)m=	48.49	43.07	35.03	26.	52	19.82	1	6.73	18.08	23.	.5	31.55	40.0	6	46.75	49.8	34		(67)
$ \begin{array}{c} \text{(a)} \text{m} & 3 \text{ (b)} (b)$	Applia	L	ins (calc	ulated i	n Apr	endix		Lat	ion L ²	13 or I 1	3a) a	also	see Tab	ble 5						
Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated uses) (calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Core Calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. FF Gains (W) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 e3.91 (76) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 e3.91 (76) East 0.9x 0.54 x	(68)m=	319.93	323.25	314.88	297	.07 2	274.59	25	3.46	239.34	236	.02	244.39	262.	2	284.68	305.	81		(68)
Counting gains (calculated in popertux 2, equation 1215 of 2104) and one rable 3 (69) m $51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 (70) The set of 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 $	Cookir			ited in /	nner	div I	equat	ion	1 15	or 15a)	ale		- Table	5						
Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2"C	(69)m-	51 91	51 91	51 91	51		51 91	5	1 91	51 91	51	0 30 91	51.91	51 9	1	51 91	51 0	31		(69)
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Dump	and fo		(Table	50)		01.01	Ľ			01.		01.01	01.0		01.01	01.0			()
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	(70)m-				5a)		0		0	0	0		0	0	_	0	0			(70)
Losses e.g. evaporation (negative values) (Table 5) (71)m = $\frac{-96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63}$ (71) Water heating gains (Table 5) (72)m = $\frac{126.2}{124.08} \frac{119.69}{113.72} \frac{113.72}{109.84} \frac{104.38}{104.38} \frac{99.74}{105.69} \frac{107.8}{107.8} \frac{113.98}{113.98} \frac{120.96}{124.09}$ (72) Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m = $\frac{594.84}{590.62} \frac{569.82}{593.53} \frac{504.48}{50.44} \frac{474.8}{457.39} \frac{465.44}{483.96} \frac{483.96}{516.46} \frac{552.62}{552.62} \frac{579.97}{57.97}$ (73) 6. Solar gains Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux g_ Flux g_ FFF Gains Table 6b Table 6c (W) East 0.9x 0.54 × 11.1 × 19.64 × 0.5 × 0.8 = 42.38 (76) East 0.9x 0.54 × 11.1 × 63.27 × 0.5 × 0.8 = 136.53 (76) East 0.9x 0.54 × 11.1 × 0.5 × 0.8 = 136.53 (76) East 0.9x 0.54 × 11.1 × 113.09 × 0.5 × 0.8 = 136.53 (76) East 0.9x 0.54 × 11.1 × 113.09 × 0.5 × 0.8 = 244.04 (76) East 0.9x 0.54 × 11.1 × 113.09 × 0.5 × 0.8 = 244.04 (76) East 0.9x 0.54 × 11.1 × 113.09 × 0.5 × 0.8 = 244.04 (76) East 0.9x 0.54 × 11.1 × 111.0 × 0.5 × 0.8 = 244.04 (76) East 0.9x 0.54 × 11.1 × 110.22 × 0.5 × 0.8 = 237.83 (76) East 0.9x 0.54 × 11.1 × 110.22 × 0.5 × 0.8 = 237.83 (76) East 0.9x 0.54 × 11.1 × 110.22 × 0.5 × 0.8 = 237.83 (76) East 0.9x 0.54 × 11.1 × 110.22 × 0.5 × 0.8 = 237.83 (76) East 0.9x 0.54 × 11.1 × 110.22 × 0.5 × 0.8 = 237.83 (76) East 0.9x 0.54 × 11.1 × 110.22 × 0.5 × 0.8 = 237.83 (76) East 0.9x 0.54 × 11.1 × 110.22 × 0.5 × 0.8 = 237.83 (76) East 0.9x 0.54 × 11.1 × 110.22 × 0.5 × 0.8 = 237.83 (76) East 0.9x 0.54 × 11.1 × 110.22 × 0.5 × 0.8 = 237.83 (76) East 0.9x 0.54 × 11.1 × 110.22 × 0.5 × 0.8 = 237.83 (76) East 0.9x 0.54 × 11.1 × 110.22 × 0.5 × 0.8 = 237.83 (76) East 0.9x 0.54 × 11.1 × 110.22 × 0.5 × 0.8 = 237.83 (76) East 0.9x 0.54 × 11.1 × 110.22 × 0.5 ×									-\		0			0		U	0			(10)
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Losses			n (nega					5) NG 62	06.62	06	62	06.62	06.6	22	06.62	06	60	1	(71)
Water heating gains (1able 5) (72)me 126.2 124.08 119.69 113.72 109.84 104.38 99.74 105.69 107.8 113.98 120.96 124.09 (72) Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)me 594.84 590.62 569.82 537.53 504.48 457.39 465.44 483.96 516.46 552.62 579.97 (73) 6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux 9 0.5 x 0.8 = 42.38 (76) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 42.38 (76) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 136.53 (76) East 0.9x 0.54 x 11.1 x 132.7 x<	(71)m=	-90.03	-90.03	-90.03	-96	63 -	90.03	-5	90.03	-90.03	-90.	03	-90.03	-96.0	55	-90.03	-90.	03		(71)
$ \begin{array}{c} (72) \text{m} = & 126.2 & 124.08 & 119.69 & 113.72 & 109.84 & 104.38 & 99.74 & 105.69 & 107.8 & 113.98 & 120.96 & 124.09 & (72) \\ \hline \text{Total internal gains = } & (66) \text{m} + (67) \text{m} + (68) \text{m} + (69) \text{m} + (70) \text{m} + (71) \text{m} + (72) \text{m} \\ \hline (73) \text{m} = & 594.84 & 590.62 & 569.82 & 537.53 & 504.48 & 474.8 & 457.39 & 465.44 & 483.96 & 516.46 & 552.62 & 579.97 & (73) \\ \hline \text{G. Solar gains} \\ \hline \text{G. Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \hline \text{Orientation: Access Factor Table 6d m2 Table 6a and associated equations to convert to the applicable orientation. \\ \hline \text{Gains Table 6d m2 Table 6a and associated equations to convert to the applicable orientation. \\ \hline \text{Gains Table 6d m2 Table 6a Table 6b Table 6b G (W) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 19.64 \times 0.5 \times 0.8 = 42.38 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 92.28 \times 0.5 \times 0.8 = 136.53 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 113.09 \times 0.5 \times 0.8 = 199.13 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 113.09 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 113.09 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 115.77 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 115.77 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 115.77 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 115.77 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 115.77 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 115.77 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = 237.83 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = 237.83 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 111.1 \times 110.22 \times 0.5 \times 0.8 = 237.8$	Water	heating	gains (1	able 5)				<u> </u>												(70)
Total internal gains = (66)m + (67)m + (68)m + (70)m + (71)m + (72)m (73)m= 594.84 590.62 597.53 504.48 474.8 457.39 465.44 483.96 516.46 552.62 579.97 (73) 6. Solar gains Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Table 6d Area Table 6a Flux g_ fable 6b FF Gains (W) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 42.38 (76) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 136.53 (76) East 0.9x 0.54 x 11.1 x 13.09 x 0.5 x 0.8 = 136.53 (76) East 0.9x 0.54 x 11.1 x	(72)m=	126.2	124.08	119.69	113	.72 1	09.84	10	04.38	99.74	105	.69	107.8	113.9	98	120.96	124.	09		(72)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Total i	nternal	gains =						(66)	m + (67)m	+ (68	3)m +	- (69)m + (70)m -	+ (71)m + (72)	m		l	(70)
6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Table 6d Area m ² Flux Table 6a g_{-} FF Table 6b Table 6c (W) East $0.9x$ 0.54 x 11.1 x 19.64 x 0.5 x 0.8 $=$ 42.38 (76) East $0.9x$ 0.54 x 11.1 x 38.42 x 0.5 x 0.8 $=$ 42.38 (76) East $0.9x$ 0.54 x 11.1 x 38.42 x 0.5 x 0.8 $=$ 42.38 (76) East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 $=$ 136.53 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 $=$ 244.04 (76) x 19.3	(73)m=	594.84	590.62	569.82	537	.53 5	504.48	4	74.8	457.39	465	.44	483.96	516.4	46	552.62	579.	97		(73)
Orientation:Access Factor Table 6dArea m²Flux Table 6a g_{-} Table 6bFF Table 6cGains (W)East0.9x0.54x11.1x19.64x0.5x0.8=42.38(76)East0.9x0.54x11.1x38.42x0.5x0.8=42.38(76)East0.9x0.54x11.1x63.27x0.5x0.8=82.91(76)East0.9x0.54x11.1x63.27x0.5x0.8=199.13(76)East0.9x0.54x11.1x113.09x0.5x0.8=199.13(76)East0.9x0.54x11.1x115.77x0.5x0.8=244.04(76)East0.9x0.54x11.1x115.77x0.5x0.8=249.81(76)East0.9x0.54x11.1x110.22x0.5x0.8=237.83(76)East0.9x0.54x11.1x110.22x0.5x0.8=237.83(76)East0.9x0.54x11.1x110.22x0.5x0.8=237.83(76)East0.9x0.54x11.1x <t< td=""><td>6. SO</td><td>lar gain:</td><td>S:</td><td></td><td>or flux</td><td>rom To</td><td></td><td>and</td><td>00000</td><td>inted aqua</td><td>tiona</td><td>to oo</td><td>nvort to th</td><td>o oppli</td><td>ioobl</td><td>o oriontati</td><td>ion</td><td></td><td></td><td></td></t<>	6. SO	lar gain:	S:		or flux	rom To		and	00000	inted aqua	tiona	to oo	nvort to th	o oppli	ioobl	o oriontati	ion			
Contentation:Access FactorAreaFlux g_{-} Flux g_{-} Flux g_{-} Flux g_{-}				asing soi		roo		anu	Elu	v	lions			e appli	Cabi		ion.		Gaine	
East $0.9x$ 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 42.38 (76) East $0.9x$ 0.54 x 11.1 x 38.42 x 0.5 x 0.8 = 82.91 (76) East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 = 136.53 (76) East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 = 136.53 (76) East $0.9x$ 0.54 x 11.1 x 92.28 x 0.5 x 0.8 = 199.13 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 111.1 x 94.68 x 0.5 x 0.8 = 204.3 (76)	Unenta	-	Table 6d	acioi	P	m²			Tab	x ble 6a		Т	9_ able 6b		Та	ble 6c			(W)	
East $0.9x$ 0.54 x 11.1 x 38.42 x 0.5 x 0.8 = 82.91 (76) East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 = 136.53 (76) East $0.9x$ 0.54 x 11.1 x 92.28 x 0.5 x 0.8 = 199.13 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 11.1 x 94.68 x 0.5 x 0.8 = 204.3 (76)	East	0.9x	0.54)	(11.1		x	1	9.64	x		0.5	×		0.8		=	42.38	(76)
East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 = 136.53 (76) East $0.9x$ 0.54 x 11.1 x 92.28 x 0.5 x 0.8 = 199.13 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 11.1 x 94.68 x 0.5 x 0.8 = 204.3 (76)	East	0.9x	0.54)	(11.1		x	3	8.42	x		0.5	x	Γ	0.8		=	82.91	(76)
East $0.9x$ 0.54 x 11.1 x 92.28 x 0.5 x 0.8 = 199.13 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 11.1 x 94.68 x 0.5 x 0.8 = 204.3 (76)	East	0.9x	0.54	;	· 🕅	11.1		x	6	3.27	x		0.5	×	Γ	0.8		=	136.53	(76)
East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 111.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 111.1 x 94.68 x 0.55 x 0.8 = 204.3 (76)	East	0.9x	0.54	,	(11.1		x	9	2.28	x		0.5	×	F	0.8		=	199.13	(76)
East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 111.1 x 94.68 x 0.55 x 0.8 = 204.3 (76)	East	0.9x	0.54	,		11.1		x	1′	13.09	x		0.5	×		0.8		=	244.04	(76)
East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 11.1 x 94.68 x 0.5 x 0.8 = 237.83 (76)	East	0.9x	0.54	,		11.1		x	1′	15.77	x	·	0.5	۲×	F	0.8		=	249.81	(76)
East $0.9x$ 0.54 x 11.1 x 04.68 x 0.5 x 0.8 = 204.3 (76)	East	0.9x	0.54	,		11.1		x	1'	10.22	x		0.5	۲ × آ	F	0.8		=	237.83	(76)
	East	0.9x	0.54	,		11.1		x	9	4.68	x		0.5	× ٦		0.8		=	204.3	(76)

East	0.9x	0.54	x	11.1	x	73.59	×	0.5	×	0.8	=	158.79	(76)
East	0.9x	0.54	×	11.1	x	45.59] × [0.5	×	0.8	=	98.37	(76)
East	0.9x	0.54	x	11.1	x	24.49	_ × [0.5	×	0.8	=	52.84	(76)
East	0.9x	0.54	x	11.1	x	16.15] × [0.5	×	0.8	=	34.85	(76)
West	0.9x	0.77	x	5.6	x	19.64] × [0.5	×	0.8	=	30.49	(80)
West	0.9x	0.77	x	5.6	x	38.42] × [0.5	×	0.8	=	59.64	(80)
West	0.9x	0.77	×	5.6	x	63.27] × [0.5	×	0.8	=	98.22	(80)
West	0.9x	0.77	×	5.6	x	92.28	Ī × [0.5	×	0.8	=	143.25	(80)
West	0.9x	0.77	x	5.6	x	113.09] × [0.5	×	0.8	=	175.56	(80)
West	0.9x	0.77	×	5.6	x	115.77	¯] × ¯	0.5	×	0.8	=	179.71	(80)
West	0.9x	0.77	x	5.6	x	110.22] × [0.5	×	0.8	=	171.09	(80)
West	0.9x	0.77	×	5.6	x	94.68] × [0.5	×	0.8	=	146.97	(80)
West	0.9x	0.77	×	5.6	x	73.59] × [0.5	×	0.8	=	114.23	(80)
West	0.9x	0.77	x	5.6	x	45.59	_ × [0.5	×	0.8	=	70.77	(80)
West	0.9x	0.77	x	5.6	x	24.49	x	0.5	x	0.8	=	38.01	(80)
West	0.9x	0.77	x	5.6	x	16.15	_ x [0.5	×	0.8	=	25.07	(80)
Solar	gains in	watts, calcu	lated	for each mon	th	i	(83)m =	Sum(74)m	. <mark>(8</mark> 2)m			1	
(83)m=	72.87	142.55 23	4.75	342.37 419.59	9 4	29.53 408.93	351.2	6 273.03	169.14	90.86	59.92		(83)
Total	gains – ii	nternal and	solar	(84)m = (73)n	ו + (ד	83)m , watts				_		1	(5.1)
(84)m=	667.71	733.17 80	4.58	879.9 924.0	7 9	04.33 866.32	816.	7 756.99	685.6	643.48	639.89		(84)
7. Me	ean <mark>inter</mark>	nal tempera	ature (heating seaso	n)								
7. Me Tem	ean inter perature	nal tempera during heat	ature (ting pe	heating seaso	on) ving	area from Ta	ıble 9, ⁻	Th1 (°C)				21	(85)
7. Me Tem Utilis	ean inter perature ation fac	nal tempera during heat tor for gains	ature (ting pe s for li	heating seaso eriods in the liv ving area, h1,	on) ving m (s	area from Ta ee Table 9a)	ible 9, ⁻	Th1 (°C)				21	(85)
7. Me Tem Utilis	ean inter perature ation fac Jan	nal tempera during heat tor for gains Feb	ature (ting pe s for li Mar	heating seaso eriods in the liv ving area, h1, Apr May	on) ving m (s	area from Ta ee Table 9a) Jun Jul	ible 9, ⁻ Au	Th1 (°C) g Sep	Oct	Nov	Dec	21	(85)
7. Me Tem Utilis (86)m=	ean inter perature ation fac Jan 0.83	nal tempera during heat stor for gains Feb f 0.77 0	ature (ting pe s for li Mar .67	heating seaso eriods in the liv ving area, h1, Apr May 0.53 0.4	on) ving m (s	area from Ta ee Table 9a) Jun Jul 0.28 0.2	ble 9, ⁻ Au	Th1 (°C) g Sep 0.36	Oct 0.58	Nov 0.76	Dec 0.84	21	(85)
7. Ma Temp Utilis (86)m= Mear	ean inter perature ation fac Jan 0.83	nal tempera during heat tor for gains Feb I 0.77 0 I temperatu	ting pe s for li Mar .67 re in li	heating seaso eriods in the lir ving area, h1, Apr May 0.53 0.4 iving area T1	on) ving m (s /	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to	ble 9, ⁻ Au 0.22 7 in Ta	Th1 (°C) g Sep 0.36 uble 9c)	Oct 0.58	Nov 0.76	Dec 0.84	21	(85)
7. Mo Tem Utilis (86)m= Mear (87)m=	ean inter perature ation fac Jan 0.83 n interna 20.63	nal tempera during heat stor for gains Feb I 0.77 0 I temperatur 20.74 20	ature (ting pe s for li Mar 0.67 re in li 0.87	heating seasoeriods in the living area, h1,AprMay0.530.4iving area T120.9620.99	ving m (s /	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21	ble 9, ⁻ Au 0.22 7 in Ta 21	Th1 (°C) g Sep 0.36 ble 9c) 21	Oct 0.58 20.95	Nov 0.76 20.79	Dec 0.84 20.59	21	(85) (86) (87)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp	ean inter perature ation fac Jan 0.83 n interna 20.63 perature	nal tempera during heat stor for gains Feb I 0.77 0 I temperatu 20.74 20 during heat	ting pe ting pe S for li Mar 0.67 re in li 0.87 ting pe	heating seaso eriods in the liv ving area, h1, Apr May 0.53 0.4 iving area T1 20.96 20.99 eriods in rest o	on) ving m (s / (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from T	ble 9, Au 0.22 7 in Ta 21 able 9,	Th1 (°C) g Sep 0.36 ble 9c) 21 Th2 (°C)	Oct 0.58 20.95	Nov 0.76 20.79	Dec 0.84 20.59	21	(85) (86) (87)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5	nal temperativeduring heatctor for gainsFeb0.7701 temperature20.7420.7420.52	ture (ting pe s for li Mar 0.67 re in li 0.87 ting pe	heating seaseeriods in the living area, h1,AprMay0.530.4iving area T120.9620.99eriods in rest of20.5120.51	on) ving m (s / (follo of dw	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from T 20.51 20.51	ble 9, Au 0.22 7 in Ta 21 able 9, 20.5	Th1 (°C) g Sep 0.36 ble 9c) 21 Th2 (°C) 1 20.51	Oct 0.58 20.95 20.51	Nov 0.76 20.79 20.51	Dec 0.84 20.59 20.5	21	(85) (86) (87) (88)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac	nal temperationduring heatctor for gainsFeb0.7701 temperature20.7420.7420.52ctor for gains	ture (ting pe s for li Mar 0.67 re in li 0.87 ting pe 0.5 s for re	heating seaseeriods in the living area, h1,AprMay0.530.4iving area T120.9620.99eriods in rest of20.5120.51	n) ving m (s / (follc) (follc) (follc) (follc) (follc)) (follc)) (area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from T 20.51 20.51 ,m (see Table	ble 9, Au 0.22 7 in Ta 21 able 9, 20.5 e 9a)	Th1 (°C) g Sep 0.36 ble 9c) 21 Th2 (°C) 1 20.51	Oct 0.58 20.95 20.51	Nov 0.76 20.79 20.51	Dec 0.84 20.59 20.5	21 	(85) (86) (87) (88)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81	nal temperativeduring heatctor for gainsFeb0.770.771 temperatu20.7420.7420.52ctor for gains0.750	ture (ting pe s for li Mar 0.67 re in li 0.87 ting pe 0.5 s for re 0.66	heating seasoeriods in the living area, h1,AprMay0.530.4iving area T120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38	ving m (s / (follc 	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from T 20.51 20.51 ,m (see Table 0.26 0.18	Au 0.22 7 in Ta 21 able 9, 20.5 9a) 0.2	Th1 (°C) g Sep 0.36 ble 9c) 21 Th2 (°C) 1 20.51 0.33	Oct 0.58 20.95 20.51	Nov 0.76 20.79 20.51 0.74	Dec 0.84 20.59 20.5 0.83	21]]	(85) (86) (87) (88) (88)
7. Ma Temp Utilis (86)m= Meau (87)m= Temp (88)m= Utilis (89)m= Meau	an inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81	nal temperative during heat ctor for gains Feb I 0.77 0 I temperature 20 during heat 20 during heat 20 ctor for gains 0 0.75 0	ture (ting pe s for li Mar 0.67 re in li 0.87 ting pe 0.5 s for re 0.66	heating seaseeriods in the living area, h1,AprMay0.530.4iving area T120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwell	in) ving m (s / (follo i, h2	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from T 20.51 20.51 ,m (see Table 0.26 0.18	Au 0.22 7 in Ta 21 able 9, 20.5 9a) 0.2	Th1 (°C) g Sep 0.36 ble 9c) 21 Th2 (°C) 1 20.51 0.33 0 7 in Table	Oct 0.58 20.95 20.51 0.56	Nov 0.76 20.79 20.51 0.74	Dec 0.84 20.59 20.5 0.83	21 	(85) (86) (87) (88) (89)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20	nal temperation during heat ctor for gains Feb I 0.77 0 I temperature 20.74 20.74 20 during heat 20.5 20.5 2 ctor for gains 0.75 0.75 0 I temperature 20.16	ture (ting pe s for li Mar 0.67 re in li 0.87 ting pe 0.5 s for re 0.66 re in t 0.33	heating seaseeriods in the living area, h1,AprMay0.530.4iving area T120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwe20.4520.51	ving m (s /	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from T 20.51 20.51 ,m (see Table 0.26 0.18 1 T2 (follow st 20.51 20.51	Aug 0.22 7 in Ta 21 able 9, 20.5 e 9a) 0.2 20.5 e 9a) 0.2 20.5 20.5 20.5 20.5 20.5 20.5 20.5	Th1 (°C) g Sep 0.36 ble 9c) 21 Th2 (°C) 1 20.51 0.33 o 7 in Table 1 20.51	Oct 0.58 20.95 20.51 0.56 e 9c) 20.45	Nov 0.76 20.79 20.51 0.74 20.24	Dec 0.84 20.59 20.5 0.83 19.96	21 21]]]	(85) (86) (87) (88) (89) (90)
7. Ma Temp Utilis (86)m= Mear (87)m= Temp (88)m= Utilis (89)m= Mear (90)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20	nal temperaturing heatduring heatctor for gainsFeb0.770.771 temperaturing heat20.7420.52ctor for gains0.7501 temperaturing20.1620.16	ture (ting pe s for li Mar 0.67 re in li 0.87 ting pe 0.5 s for re 0.66 re in t 0.33	heating seaseeriods in the living area, h1,AprMay0.530.4iving area T120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwe20.4520.51	in) ving (follo (follo (follo) (follo) (follo) (follo) (follo) (follo) (follo) (follo) (follo)) (follo)) (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from T 20.51 20.51 ,m (see Table 0.26 0.18 1T2 (follow st 20.51 20.51	Au 0.22 7 in Ta 21 able 9, 20.5 9a) 0.2 eps 3 t 20.5	Th1 (°C) g Sep 0.36 ble 9c) 21 Th2 (°C) 1 20.51 0.33 o 7 in Table 1 20.51 ft	Oct 0.58 20.95 20.51 0.56 20.45 20.45 20.45	Nov 0.76 20.79 20.51 0.74 20.24	Dec 0.84 20.59 20.5 0.83 19.96	0.58	(85) (86) (87) (88) (89) (90) (91)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20	nal temperative during heat ctor for gains Feb I 0.77 0 I temperature 20 during heat 20 ctor for gains 0 0.75 0 I temperature 20 20.75 0 I temperature 20 20.16 20	ture (ting pe s for li Mar 0.67 re in li 0.87 ting pe 0.5 s for re 0.66 re in t 0.33	heating seaseeriods in the living area, h1,AprMay0.530.4iving area T120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwell20.4520.51	ving m (s (follo (follo), h2), h2), h2), h2	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from T 20.51 20.51 welling from T 20.51 20.51 m (see Table 0.26 0.18 T2 (follow st 20.51 20.51	ble 9, Aug 0.22 7 in Ta 21 able 9, 20.5 e 9a) 0.2 eps 3 t 20.5	Th1 (°C) g Sep 0.36 ble 9c) 21 Th2 (°C) 1 20.51 0.33 0 7 in Table 1 20.51 ft ft A) v T2	Oct 0.58 20.95 20.51 0.56 e 9c) 20.45 20.45 A = Liv	Nov 0.76 20.79 20.51 0.74 20.24 ing area ÷ (4)	Dec 0.84 20.59 20.5 0.83 19.96 4) =	0.58	(85) (86) (87) (88) (89) (90) (91)
7. Ma Temp Utilis (86)m= Mear (87)m= Temp (88)m= Utilis (89)m= Mear (90)m= Mear (92)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20	nal temperative during heat ctor for gains Feb I 0.77 0 I temperature 20.74 20 during heat 20.5 2 ctor for gains 0.75 0 I temperature 20.16 20 I temperature 20.16 20 I temperature 20.49 20	ture (ting pe s for li Mar 0.67 re in li 0.87 ting pe 0.5 s for ro 0.66 re in t 0.33 re (for	heating seaseeriods in the lingving area, h1,AprMay0.530.4iving area T120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwelling20.4520.5r the whole dw20.7520.78	ving m (s (follc (follc) (follc) (follc) (follc)) (follc)) (foll	area from Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from T 20.51 20.51 ,m (see Table 0.26 0.18 1 T2 (follow st 20.51 20.51 20.51 20.51	Au 0.22 7 in Ta 21 able 9, 20.5 e 9a) 0.2 20.5 e 9a) 0.2 + (1 - 20.8	Th1 (°C) g Sep 0.36 ble 9c) 21 Th2 (°C) 1 20.51 0.33 o 7 in Table 1 20.51 ft fLA) x T2 20.79	Oct 0.58 20.95 20.51 0.56 9 9c) 20.45 A = Liv	Nov 0.76 20.79 20.51 0.74 20.24 ring area ÷ (4	Dec 0.84 20.59 20.5 0.83 19.96 4) =	21	(85) (86) (87) (88) (89) (90) (91)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m= Mean (90)m=	an inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20 n interna 20 n interna	nal temperaturing heat during heat itor for gains Feb I 0.77 0 I temperaturing heat 20.74 20 during heat 20.74 20 during heat 20.75 0 I temperaturing 20.16 20.16 20 I temperaturing 20.16 20.49 20 Dependent to the state 20	ture (ting pe s for li Mar 0.67 re in li 0.87 ting pe 0.5 s for re 0.66 re in t 0.33 re (for 0.64	heating seasoeriods in the living area, h1,AprMay0.530.4iving area T120.9620.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwelling20.4520.5r the whole dw20.7520.78	ving m (s (follo (follo) (follo)	area from Ta ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 velling from T 20.51 20.51 ,m (see Table 0.26 0.18 1 T2 (follow st 20.51 20.51 ag) = fLA \times T1 20.79 20.79 ure from Table	Aug 0.22 7 in Ta 21 able 9, 20.5 9a) 0.2 0.2 + (1 - 20.8 20.8 20.8 20.8	Th1 (°C) g Sep 0.36 ble 9c) 21 Th2 (°C) 1 20.51 0.33 0 7 in Table 1 20.51 ft ft ft ft ft ft A) × T2 20.79 there approximates	Oct 0.58 20.95 20.51 0.56 20.45 20.45 A = Liv 20.74	Nov 0.76 20.79 20.51 0.74 20.24 ting area ÷ (4 20.56	Dec 0.84 20.59 20.5 0.83 19.96 4) = 20.33	21	(85) (86) (87) (88) (89) (90) (91) (92)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m= Mean (92)m= Apply (93)m=	an inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20 n interna 20.36 y adjustn 20.36	nal temperation during heat ctor for gains Feb I 0.77 0 I temperature 20 20.74 20 during heat 20 20.74 20 during heat 20 20.75 0 temperature 20 0.75 0 I temperature 20 1 temperature 20 1 temperature 20 20.16 20 1 temperature 20 20.49 20	ature (ting person s for li Mar 0.67 re in li 0.87 ting person 0.66 0.66 re in t 0.33 re (for 0.64 mean 0.64	heating seaseeriods in the living area, h1,AprMay0.530.4iving areaT120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwell20.4520.5r the whole dw20.7520.78internal tempo20.7520.78	ving m (s (follo (follo) f dw) i, h2) illing illing illing illing	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from T 20.51 20.51 welling from T 20.51 20.51 yelling from T 20.51 20.51 (see Table 0.26 0.18 1 T2 (follow st 20.51 20.51 (g) = fLA × T1 20.79 20.79 ure from Table 20.79 20.79	ble 9, Aug 0.22 7 in Ta 21 able 9, 20.5 e 9a) 0.2 eps 3 t 20.5 + (1 – 20.8 e 4e, w 20.8	Th1 (°C) g Sep 0.36 ble 9c) 21 Th2 (°C) 1 20.51 0.33 0 7 in Table 1 20.51 fl fLA) × T2 20.79 rhere appro	Oct 0.58 20.95 20.51 0.56 20.45 20.45 20.45 A = Liv 20.74 priate 20.74	Nov 0.76 20.79 20.51 0.74 20.24 ing area ÷ (2 20.56	Dec 0.84 20.59 20.5 0.83 19.96 4) = 20.33	21 21 0.58	(85) (86) (87) (88) (89) (90) (91) (92) (93)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m= Mean (92)m= Apply (93)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20 n interna 20 n interna 20.36 y adjustn 20.36	nal temperaturing heat during heat ctor for gains Feb I 0.77 0 I temperaturing heat 20.74 20 during heat 20.5 ctor for gains 0.75 0.75 0 I temperaturi 20.16 20.16 20 I temperaturi 20.20 nent to the r 20.49 20.49 20 nent to the r 20.49	ture (ting pe s for li Mar i.67 re in li 0.87 ting pe 0.5 s for re 0.66 re in t 0.33 re (for 0.64 mean 0.64 ment	heating seaseeriods in the living area, h1,AprMay0.530.4iving area T120.9620.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwelling20.4520.5r the whole dw20.7520.78internal tempo20.7520.78	ving m (s (follo (follo (follo) (follo)) (follo	area from Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from T 20.51 20.51 velling from T 20.51 20.51 ,m (see Table 0.26 0.18 1 T2 (follow st 20.51 20.51 area from Table 20.79 20.79 ure from Table 20.79 20.79	ble 9, Au 0.22 7 in Ta 21 able 9, 20.5 9a) 0.2 e 9a) 0.2 + (1 - 20.8 e 4e, w 20.8	Th1 (°C) g Sep 0.36 ble 9c) 21 Th2 (°C) 1 20.51 0.33 0 7 in Table 1 20.51 fl fLA) × T2 20.79 there appro	Oct 0.58 20.95 20.51 0.56 20.45 20.45 20.45 A = Liv 20.74 priate 20.74	Nov 0.76 20.79 20.51 0.74 20.24 ing area ÷ (2 20.56	Dec 0.84 20.59 20.5 20.5 19.96 4) = 20.33 20.33	21 21 0.58	(85) (86) (87) (88) (89) (90) (91) (91) (92) (93)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m= Mean (90)m= Mean (92)m= Apply (93)m= 8. Sp Set T	an inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20 n interna 20.36 y adjustn 20.36 y adjustn 20.36	nal temperation during heat ctor for gains Feb I 0.77 0 I temperature 20 20.74 20 during heat 20 during heat 20 ctor for gains 0.75 0.75 0 I temperature 20.16 20.16 20 I temperature 20.49 20.49 20 nent to the r 20.49 20.49 20 mean intern 20.49	ture (ting pe s for li Mar 0.67 re in li 0.87 ting pe 0.5 s for re 0.66 re in t 0.33 re (for 0.64 mean 0.64 mean 0.64 mean 0.64 mean	heating seasoeriods in the living area, h1,AprMay0.530.4iving area T1 (20.96)20.99eriods in rest of20.91eriods in rest of20.51est of dwelling0.510.510.38he rest of dwelling20.4520.5120.4520.51enternal tempo20.7520.78internal tempo20.7520.78	innec	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from T 20.51 20.51 velling from T 20.51 20.51 on (see Table 0.26 0.18 0.26 0.18 0.26 0.18 0.26 0.18 0.26 0.18 0.279 20.51 20.51 20.51 20.79 20.79 ure from Tabl 20.79 20.79 20.79 d at step 11 o	ble 9, Au, 0.22 7 in Ta 21 able 9, 20.5 e 9a) 0.2 eps 3 t 20.5 + (1 – 20.8 e 4e, w 20.8 f Table	Th1 (°C) g Sep 0.36 ble 9c) 21 Th2 (°C) 1 20.51 0.33 0 7 in Table 1 20.51 ft fLA) × T2 20.79 vhere appro 20.79 9b, so that	Oct 0.58 20.95 20.51 0.56 e 9c) 20.45 A = Liv 20.74 priate 20.74	Nov 0.76 20.79 20.51 0.74 20.24 ing area ÷ (4 20.56 20.56 20.56	Dec 0.84 20.59 20.5 0.83 19.96 4) = 20.33 20.33 20.33	21 21	(85) (86) (87) (88) (89) (90) (91) (92) (93)
7. Ma Temp Utilis (86)m= Mear (87)m= Temp (88)m= Utilis (89)m= Mear (90)m= Mear (90)m= Mear (92)m= Apply (93)m= 8. Sp Set T the u	an inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20 n interna 20.36 y adjustn 20.36 y adjustn 20.36 ri to the ri tilisation	nal temperature during heat ctor for gains Feb I 0.77 0 I temperature 20.74 20 during heat 20.5 2 ctor for gains 0.75 0 I temperature 20.16 20 1 temperature 20.16 20 I temperature 20.16 20 I temperature 20.49 20 I temperature 20.49 20 nent to the r 20.49 20 mean intern factor for g 10	ature (ting person s for li Mar 0.67 re in li 0.87 ting person ting person to.67 re in li 0.67 s for re 0.66 re in t 0.66 re (for 0.64 mean 0.64 ment al tem ains u	heating seaseeriods in the lingving area, h1,AprMay0.530.4iving area T120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwelling20.4520.5r the whole dw20.7520.78internal tempo20.7520.78internal tempo20.7520.78an operature obtausing Table 9a	innec	area from Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from T 20.51 20.51 welling from T 20.51 20.51 ym (see Table 0.26 0.18 1 T2 (follow st 20.51 20.51 are from Table 20.79 20.79 ure from Table 20.79 20.79 at step 11 o	Au 0.22 7 in Ta 21 able 9, 20.5 9a) 0.2 e 9a) 0.2 e 9a) 20.5 e 9a) 20.5 e 9a) 20.5 e 4e, w 20.8 e 4e, w 20.8 f Table	Th1 (°C) g Sep 0.36 ble 9c) 21 Th2 (°C) 1 20.51 0.33 0 7 in Table 1 20.51 ft fLA) × T2 20.79 where appro 20.79 9b, so that	Oct 0.58 20.95 20.51 0.56 20.45 20.45 20.45 20.74 20.74 priate 20.74	Nov 0.76 20.79 20.51 0.74 20.24 ing area ÷ (4 20.56 20.56 20.56	Dec 0.84 20.59 20.5 0.83 19.96 4) = 20.33 20.33 d re-calc	21 21 0.58	(85) (86) (87) (88) (89) (90) (91) (91) (92) (93)

Utilisa	ation fac	tor for g	ains, hm	n:										
(94)m=	0.81	0.75	0.66	0.52	0.39	0.27	0.19	0.21	0.35	0.57	0.74	0.83		(94)
Usefu	I gains,	hmGm	, W = (94	4)m x (84	4)m									
(95)m=	540.92	553.11	531.08	461.17	359.97	244.46	165.79	173.3	264.26	389.56	477.82	529.03		(95)
Month	nly aver	age exte	ernal tem	perature	e from Ta	able 8	·	i	i	·	i	i	I	
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat	loss rate	e for me	an interr	al tempe	erature,	Lm , W =	=[(39)m : L 405 00	x [(93)m	– (96)m]	E 40.07	050.40		(07)
(97)m=	653.04	632.59	572.42	474.44	362.99	244.88	165.86	1/3.4	$\frac{265.64}{0}$	405.16	1)m	650.13		(97)
Space (98)m=	83 42	53 41	30.76	9.56	2 25		n = 0.02	24 X [(97)m – (95 1 o) III] X (4	44 97	90.1		
()								Tota	l per vear	(kWh/vear	r) = Sum(9	8)1 59 12 =	326.06	(98)
Space	e heatin	a require	ement in	kWh/m²	/vear					(· /1	4.2	_`´´](99)
	oray roo	uiromor		mmunity	hooting	aabama								
90. EN This or	ergy rec	uiremer od for cr	$\pi s = Cor$	mmunity		scheme	ator boo	ting prov	idod by	2 comm		omo		
Fractio	n of spa	ace heat	from se	condary/	supplen/	nentary l	neating ((Table 1	1) '0' if n	one	unity Sci	leme.	0	(301)
Fractio	n of spa	ace heat	from co	mmunity	system	1 – (301	1) =						1	(302)
The con	nmunity so	heme ma	y obtain he	eat from se	everal sou	rces. The p	procedure	allows for	CHP and	up to four	other heat	sources; t	he latter	_
includes Eractio	boilers, h	eat pump	s, geotheri	mal and wa	aste heat f	rom powei	r stations.	See Appe	ndix C.				4	
	IT OF HER		Johnmun		5								1	_(303a)
Fractio	n of tota	al space	heat fro	m Comn	nunity bo	bilers				(3	02) x (303	a) =	1	(304a)
Factor	for cont	rol and	charging	method	(Table	4c(3)) fo	r commu	unity hea	ating sys	tem			1	(305)
Distrib	ution los	s factor	(Table 1	12c) for c	commun	ity heatir	ng syste	m					1.07	(306)
Spa <mark>ce</mark>	heating	3											k <mark>Wh/y</mark> ear	-
Ann <mark>ua</mark>	l space	heating	requiren	nent									3 <mark>26.06</mark>	
Space	heat fro	m Com	munity b	oilers					(98) x (30	04a) x (30	5) x (306) :	=	348.88	(307a)
Efficier	ncy of se	econdar	y/supple	mentary	heating	system	in % (fro	om Table	e 4a or A	ppendix	E)		0	(308
Space	heating	require	ment fro	m secon	dary/su	oplemen	tary syst	tem	(98) x (30	01) x 100 -	÷ (308) =		0	(309)
Water	heating	I												_
Annua	l water h	neating I	requirem	ent									2091.65	
If DHW Water	/ from c heat fro	ommuni m Comr	ty schen nunity bo	ne: oilers					(64) x (30	03a) x (30	5) x (306) :	=	2238.07	(310a)
Electric	city used	d for hea	at distrib	ution				0.01	× [(307a)	(307e) +	- (310a)((310e)] =	25.87	(313)
Cooling	g Syster	n Energ	y Efficie	ncy Ratio	0								0	(314)
Space	cooling	(if there	is a fixe	ed cooling	g systen	n, if not e	enter 0)		= (107) ÷	· (314) =			0	(315)
Electric mecha	city for p nical ve	oumps a ntilation	nd fans - balanc	within dv ced, extra	velling (T act or po	Fable 4f) sitive inj	: put from	outside					250.5	(330a)
warm a	air heati	ng syste	m fans										0	(330b)
pump f	or solar	water h	eating										0	(330g)
Total e	lectricity	/ for the	above, l	kWh/yea	r				=(330a) ·	+ (330b) +	(330g) =		250.5	(331)
	-													

Energy for lighting (calculated in Append	lix L)		342.54 (332)
10b. Fuel costs – Community heating s	cheme		
	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating from CHP	(307a) x	4.24 ×	0.01 = 14.79 (340a)
Water heating from CHP	(310a) x	4.24 ×	0.01 = 94.89 (342a)
		Fuel Price	
Pumps and fans	(331)	13.19 ×	0.01 = 33.04 (349)
Energy for lighting	(332)	13.19 ×	0.01 = 45.18 (350)
Additional standing charges (Table 12)			120 (351)
Total energy cost	= (340a)(342e) + (345)(354) =		307.91 (355)
11b. SAP rating - Community heating s	cheme		
Energy cost deflator (Table 12)			0.42 (356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =		1.05 (357)
SAP rating (section12)			85.29 (358)
CO2 from other sources of space and w Efficiency of heat source 1 (%) CO2 associated with heat source 1 Electrical energy for heat distribution	Ene kW ater heating (not CHP) If there is CHP using two fuels ((307b)+(310b)] x 7 [(313) x	ergy h/year Emission f kg CO2/kV s repeat (363) to (366) for the se 100 ÷ (367b) x 0.22 0.52	factor Emissions Wh kg CO2/year cond fuel 92 (367a) = 607.37 (367) = 13.43 (372)
Total CO2 associated with community s	ystems (363)(36	66) + (368)(372)	= 620.8 (373)
CO2 associated with space heating (see	condary) (309) x	0	= 0 (374)
CO2 associated with water from immers	ion heater or instantaneous hea	ater (312) x 0.22	= 0 (375)
Total CO2 associated with space and wa	ater heating (373) + (3	74) + (375) =	620.8 (376)
CO2 associated with electricity for pump	s and fans within dwelling (331)) x 0.52	= 130.01 (378)
CO2 associated with electricity for lightin	ng (332))) x	0.52	= 177.78 (379)
Total CO2, kg/year	sum of (376)(382) =		928.59 (383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =		11.97 (384)
El rating (section 14)			89.85 (385)
13b. Primary Energy – Community heati	ng scheme		
	Ene kW	ergy Primary h/year factor	P.Energy kWh/year
Energy from other sources of space and Efficiency of heat source 1 (%)	water heating (not CHP) If there is CHP using two fuels	s repeat (363) to (366) for the se	- econd fuel 92 (367a)
Energy associated with heat source 1	[(307b)+(310b)] x ⁻	100 ÷ (367b) x 1.22	= 3430.52 (367)
Electrical energy for heat distribution	[(313) x		= 79.42 (372)

Total Energy associated with community systems	(363)(366) + (368)(372)		=	3509.94	(373)
if it is negative set (373) to zero (unless specified otherwise,	see C7 in Appendix C)			3509.94	(373)
Energy associated with space heating (secondary)	(309) x	0	=	0	(374)
Energy associated with water from immersion heater or instan	taneous heater(312) x	1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =			3509.94	(376)
Energy associated with space cooling	(315) x	3.07	=	0	(377)
Energy associated with electricity for pumps and fans within de	welling (331)) x	3.07	=	769.04	(378)
Energy associated with electricity for lighting	(332))) x	3.07	=	1051.61	(379)
Total Primary Energy, kWh/year sum of (376)	(382) =			5330.59	(383)



		Use	er Details:						
Assessor Name: Software Name:	Stroma FSAP 2012	2	Stroma Softwa	a Numi ire Ver	ber: sion:		Versio	n: 1.0.4.18	
		Prope	erty Address:	11_s_m	1				
Address :	Block I, Agar Grove,	Camden, Lo	ondon, NW1	9TB					
1. Overall dwelling dime	ensions:		(m ²)			iaht(m)		Volumo(m ³)	
Ground floor			77.6	(1a) x	АV. Пе	.15	(2a) =	244.44	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)	+(1n)	77.6	(4)					
Dwelling volume				(3a)+(3b)	+(3c)+(3d	l)+(3e)+	.(3n) =	244.44	(5)
2. Ventilation rate:	·								
	main se heating he	condary eating	other		total			m ³ per hour	•
Number of chimneys	0 +	0 +	0] = [0	x 4	= 0	0	(6a)
Number of open flues	0 +	0 +	0] = [0	x 2	20 =	0	(6b)
Number of intermittent fa	ns			, r	0	x 1	0 =	0	(7a)
Number of passive vents	i				0	x 1	0 =	0	(7b)
Number of flueless gas fi	res				0	× 4	40 =	0	(7c)
							Air ch	ange <mark>s per</mark> ho	ur
Infiltration due to chimne	ys, flues and fans = (6a)+(6b)+(7a)+(7	/b)+(7c) = 17) otherwise c	ontinue fro	0	(16)	÷ (5) =	0	(8)
Number of storeys in the	ne dwelling (ns)	a, proceed to (, (o) to (10)	[0	(9)
Additional infiltration						[(9)-	1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber fi	rame or 0.35	5 for masonr	y constr	uction			0	(11)
if both types of wall are pl	resent, use the value corresp	onding to the g	greater wall area	a (after					
If suspended wooden f	iloor. enter 0.2 (unseale	ed) or 0.1 (se	ealed), else	enter 0			[0	T (12)
If no draught lobby, en	ter 0.05, else enter 0	, (,,					0	(13)
Percentage of windows	s and doors draught str	ipped						0	(14)
Window infiltration			0.25 - [0.2	x (14) ÷ 1	= [00			0	(15)
Infiltration rate			(8) + (10) -	+ (11) + (1	2) + (13) +	+ (15) =		0	(16)
Air permeability value,	q50, expressed in cubi	c metres pe	r hour per so	quare me	etre of e	nvelope	area	1	(17)
If based on air permeabil	ity value, then $(18) = [(17)]$	') ÷ 20]+(8), oth	nerwise (18) = (16)				0.05	(18)
Air permeability value applie	es if a pressurisation test has	been done or a	a degree air per	meability i	s being us	sed	r		
Shelter factor	iu		(20) = 1 - [0.075 x (1	9)] =			0.85	(19)
Infiltration rate incorporat	ing shelter factor		(21) = (18)	x (20) =			l	0.03	(20)
Infiltration rate modified f	or monthly wind speed						l	0.04	
Jan Feb	Mar Apr May	Jun Ju	ul Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	eed from Table 7	•							
(22)m= 5.1 5	4.9 4.4 4.3	3.8 3.	8 3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (22	2)m ÷ 4			I					
(22a)m= 1.27 1.25	1.23 <u>1.1</u> 1.08	0.95 0.9	95 0.92	1	1.08	1.12	1.18		

Adjust	ed infiltr	ation rate	e (allowi	ing for sh	nelter an	d wind s	peed) =	(21a) x	(22a)m					
_	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.05		
Calcul	ate effe	ctive air	change	rate for t	he appli	cable ca	se		-		-	-	-	
IT ME	ecnanica		tion:	" N (0		、 - (. (00)				0.5	(23a)
If exh	aust air h	eat pump (using App	endix N, (2	(23a) = (23a	i) × Fmv (e	equation (P	N5)), othe	rwise (23b) = (23a)			0.5	(23b)
lf bala	anced with	heat reco	overy: effic	ciency in %	allowing f	or in-use f	actor (from	n Table 4h) =				76.5	(23c)
a) If	balance	ed mecha	anical ve	entilation	with hea	at recove	ery (MVI	HR) (24a	a)m = (22	2b)m + (1	23b) × [1 – (23c)) ÷ 100]	
(24a)m=	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17		(24a)
b) If	balance	ed mecha	anical ve	entilation	without	heat rec	overy (N	ИV) (24b)m = (22	2b)m + (2	23b)	-	_	
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If	whole h	ouse ex	tract ver	ntilation o	or positiv	e input v	ventilatio	on from c	outside					
i	if (22b)n	n < 0.5 ×	: (23b), t	then (24	c) = (23b); otherv	wise (24	c) = (22b	o) m + 0.	5 × (23b)			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If	natural	ventilatio	on or wh	ole hous	se positiv	ve input	ventilatio	on from I	oft					
i	if (22b)n	n = 1, the	en (24d))m = (22b T	o)m othe	erwise (2	4d)m = 0	0.5 + [(2	2b)m² x	0.5]			1	<i>(</i> - -)
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effe	ctive air	change	rate - er	nter (24a) or (24t	o) or (24	c) or (24	d) in boy	k (25)				•	
(25)m=	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17		(25)
3. He	at losse	s and he	at loss i	paramete	er:									_
		Gros	s	Openin	as	Net Ar	ea	U-valı	ue	AXU		k-valu	e A	A X k
		area	(m²)	m	12	A ,r	n²	W/m2	2K	(W/I	K)	kJ/m ² ·	K I	J/K
Windo	ws Type	e 1				5.6	×1/	[1/(0.85)+	+ 0.04] =	4.6				(27)
Windo	ws Type	2				11.1	x1/	[1/(0.85)+	+ 0.04] =	9.12				(27)
Walls ⁻	Type1	38.4	4	11.1		27.3	X	0.2	i - T	5.46	Fir			(29)
Walls ⁻	Tvpe2	8.5		5.6		29		0.2		0.58				(29)
Total a	irea of e		m²			46.0		0.2	[0.00	L			(31)
* for win	dows and	roof winde	, ows. use e	effective wi	ndow U-va	alue calcul	 ated usino	i formula 1	/I(1/U-valu	ie)+0.041 a	as aiven in	paragrap	132	(01)
** inclua	le the area	as on both	sides of ir	nternal wal	ls and part	titions	atou aonig	, ionnaid i	//(<i>ii</i> /c ⁻ /aia	<i></i>	ie gireir ii	pulugiupi		
Fabric	heat los	s, W/K =	= S (A x	U)				(26)(30)) + (32) =				19.77	(33)
Heat c	apacity	Cm = S(Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	513.4	(34)
Therm	al mass	parame	ter (TMI	P = Cm ÷	- TFA) ir	n kJ/m²K			Indica	tive Value	: Low		100	(35)
For desi	gn assess	sments wh	ere the de	etails of the	construct	ion are not	t known pr	ecisely the	e indicative	values of	TMP in T	able 1f		
can be ι	ised inste	ad of a dei	tailed calc	ulation.										
Therm	al bridg	es : S (L	x Y) cal	culated u	using Ap	pendix ł	<						7.04	(36)
if details	of therma	al bridging	are not kr	10wn (36) =	= 0.05 x (3	1)			(00)	(00)				
	abric ne	at loss							(33) +	(36) =			26.8	(37)
Ventila	ition hea	at loss ca	alculated	d monthly	y I			1	(38)m	= 0.33 × (25)m x (5) I)	1	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	13.85	13.76	13.68	13.25	13.16	12.74	12.74	12.65	12.91	13.16	13.33	13.51	J	(38)
Heat tr	ansfer o	coefficier	nt, W/K						(39)m	= (37) + (3	38)m		_	
(39)m=	40.65	40.57	40.48	40.05	39.97	39.54	39.54	39.45	39.71	39.97	40.14	40.31		
										Average =	Sum(39)	12 /12=	40.03	(39)
Heat lo	oss para	imeter (H	HLP), W	/m²K	-			<u> </u>	(40)m	= (39)m ÷	· (4)	<u> </u>	1	
(40)m=	0.52	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.51	0.52	0.52	0.52		(
									/	Average =	Sum(40)1	₁₂ /12=	0.52	(40)
Numbe	er of day	rs in moi	nth (Tab	le 1a)			-		-	-	-	-		
---	-------------------------------------	--	--------------------------------------	---	---	---------------------------------------	------------------------------	---	-----------------------	---------------------------	---------------------------------------	-------------	------------	--------------
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Wa	ater heat	ing enei	rgy requ	irement:								kWh/ye	ear:	
Assum if TF if TF	ied occu A > 13.9 A £ 13.9	ipancy, l 9, N = 1 9, N = 1	N + 1.76 x	[1 - exp	(-0.0003	349 x (TF	⁻ A -13.9)2)] + 0.(0013 x (⁻	TFA -13.	<u>2</u> . 9)	42		(42)
Annua Reduce not more	l averag the annua e that 125	e hot wa Il average litres per l	ater usag hot water person pel	ge in litre usage by r dav (all w	es per da 5% if the d ater use. I	ay Vd,av Iwelling is not and co	erage = designed i ld)	(25 x N) to achieve	+ 36 a water us	se target o	91 f	.57		(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Αυσ	Sen	Oct	Nov	Dec		
Hot wate	er usage in	n litres per	day for ea	ach month	Vd,m = factor	ctor from T	Table 1c x	(43)	000	000	1107	200		
(44)m=	100.73	97.07	93.41	89.74	86.08	82.42	82.42	86.08	89.74	93.41	97.07	100.73		
Energy	content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,n	n x nm x D)))))))))))))))))))) kWh/mor	Total = Su oth (see Ta	m(44) ₁₁₂ = ables 1b, 1	= c, 1d)	1098.89	(44)
(45)m=	149.38	130.65	134.82	117.54	112.78	97.32	90.18	103.49	104.72	122.04	133.22	144.67		
				1					-	Total = Su	m(45) ₁₁₂ =		1440.81	(45)
lf instan	taneous w	ater heatil	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46) to (61)					
<mark>(46)m=</mark> Water	22.41	19.6	20.22	17.63	16.92	14.6	13.53	15.52	15.71	18.31	19.98	21.7		(46)
Storag	e volum	e (litre <mark>s</mark>)	includir	ng any so	olar or W	WHRS	storage	within sa	ame ves	sel		0		(47)
lf co <mark>m</mark> Otherv Water	munity h vise if no storage	eating a stored loss:	ind no ta hot wate	ink in dw er (this ir	velling, e ncludes i	nter 110 nstantar) litres in neous co	(47) ombi boil	ers) ente	er '0' in (47)			
a) I <mark>f m</mark>	anufact	urer's de	eclared I	oss facto	or is kno	wn (kWr	n/day):					0		(48)
Tempe	erature fa	actor fro	m Table	2b								0		(49)
Energy	/ lost fro	m water	storage	e, kWh/ye	ear loss facto	or is not	known:	(48) x (49)) =		1	10		(50)
Hot wa	ater stora munity h	age loss eating s	factor fr	om Tabl	e 2 (kWl	h/litre/da	ay)				0.	02		(51)
Volum	e factor	from Ta	ble 2a								1.	03		(52)
Tempe	erature fa	actor fro	m Table	2b							0	.6	_	(53)
Energy	/ lost fro (50) or (m water 54) in (5	storage	e, kWh/y€	ear			(47) x (51)) x (52) x (53) =	1.	03		(54) (55)
Water	storage	loss cal	culated t	for each	month			((56)m = (55) × (41)ı	m	L1.	03		(00)
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(56)
If cylinde	er contains	dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (L H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	l lix H	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(57)
Primar	y circuit	loss (ar	nual) fro	om Table	e 3							0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m cylinder	r thormo	stat)			
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss cal	culated	for each	month ((61)m =	(60) ÷ 36	65 × (41)m		I	I		I	
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)

(e2)m 20.4 68 190.5 171.0.3 190.08 150.82 145.46 158.72 178.22 177.22 188.71 198.84 (e2) Stati DHW nput calculated using Appendix G or Appendix H (regative quantity) (rentry U in o solar cambulanto to water heating) (add additional lines if FGHRS applies, see Appendix G) Using the provide of the	Total h	leat req	uired for	water h	neatin	g calcul	ated	fo	r each	n month	(62)	m =	0.85 × ((45)r	n +	(46)m +	(57)r	m +	(59)m + (61)m	
Salar CMV input actualized using Appendix H meganity (emery V in a salar contribution to water heating) (add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (63) Output from water heater (64)m 20.66 180.58 180.1 171.03 168.06 150.82 145.46 158.76 158.22 177.32 186.71 199.94 (64)m 20.66 180.58 180.1 171.03 168.06 150.82 145.46 158.76 158.22 177.52 186.71 199.94 (64)m 20.66 180.58 180.1 171.03 168.06 150.82 145.46 158.76 158.22 177.52 186.71 199.94 (64)m 20.66 180.58 180.1 171.03 168.06 150.82 145.46 158.76 158.22 177.52 186.71 199.94 (65)m 20.88 83.88 80.05 81.88 81.72 76.15 74.21 78.63 77.62 84.8 87.09 92.32 (65) Include (57)m in calculation of (65)m only if cylinder is in the dwalling or hot water is from community heating 5. Internal quite Scee Table 5 and 5.5 : Wetabolic gains (Table 5), Watts (68)m 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 144.94 (65) (17)m 484.8 43.07 35.03 26.52 188.8 16.73 18.08 22.63 31.55 40.88 46.75 40.84 (65) (17)m 484.8 43.07 35.03 26.52 188.8 16.73 18.08 22.63 31.55 40.88 46.75 40.84 (67) Appliances gains (calculated in Appendix L, equation L15 or L1530 / also see Table 5 (67)m 484.8 43.07 35.03 26.52 188.8 16.73 18.08 22.64 31.55 40.88 46.75 40.84 (67) Appliances gains (calculated in Appendix L, equation L15 or L1530 / also see Table 5 (67)m 484.8 43.07 35.03 26.52 188.8 10.15 0 / L1530 / also see Table 5 (69)m 51.91 51.9	(62)m=	204.66	180.58	190.1	171	03 168	3.06	15	50.82	145.46	158	.76	158.22	177	7.32	186.71	199	.94		(62)
(add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (a) 0	Solar DI	-IW input	calculated	using Ap	pendix	G or App	endix	Н (negativ	/e quantity	v) (ent	er '0'	if no solai	r cont	tribu	tion to wate	er heat	ting)		
	(add a	dditiona	I lines if	FGHR	and/	or WWI	HRS	ар	plies,	see Ap	penc	lix C	3)	-						
Output from water heater (64)m 204.86 180.58 190.1 171.03 186.06 150.82 145.46 158.62 177.32 186.71 199.94 Upput from water heating, kWh/month 0.25 10.85 × (45)m + (61)m) + 0.8 × [(46)m + (67)m + (59)m] 2091.65 (64) (69)m 93.88 83.38 93.05 81.88 81.72 75.15 74.21 78.63 77.62 84.8 87.09 92.32 (65) Include (57)m in calculation of (65) mony if cylinder is in the dwelling or hot water is from community heating 5. Include (57)m in calculation of (65) mony if cylinder is in the dwelling or hot water is from community heating 660m 144.94 144.9	(63)m=	0	0	0	0	()		0	0	0)	0	()	0	0)		(63)
(64)me 204.66 180.58 190.1 171.03 168.06 150.82 145.46 158.76 158.22 177.32 188.71 199.94 0.00 0.05 (64) 0.00 0.00 0.201.65 (64) 93.89 03.38 08.05 81.88 0.17.2 75.15 77.42 17.83 77.62 04.8 87.09 92.32 (65) 03.89 03.38 08.05 81.88 0.17.2 71.5 77.42 17.83 77.62 04.8 87.09 92.32 (65) 180.45 5.0 17.24 78.63 77.62 04.8 87.09 92.32 (65) 199.4 Mar	Output	from w	ater hea	ter																
Undput from water heating, kWh/month 0.25 (0.85 x (45)m + (61)m) + 0.8 x [(46)m + (57)m + (59)m] (64) (65)m 93.89 83.38 89.05 81.88 81.72 75.15 74.21 78.63 77.62 84.8 87.09 92.32 (65) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from comunity heating 5.	(64)m=	204.66	180.58	190.1	171	03 168	3.06	15	50.82	145.46	158	.76	158.22	177	7.32	186.71	199	.94		_
Heat gains from water heating, kWh/month 0.25 ¹ [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] (65)m 9 8.89 8.38 8.06 81.88 81.72 75.15 74.21 78.63 77.62 84.8 87.09 82.32 (65) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Internal gains (see Table 5 and 53) : Metabolic gains (Table 5), Wats (66)m 1 141.94 144.94 149.94 1			-									Outp	out from wa	ater h	eate	er (annual) _{1.}	12		2091.65	(64)
(66)me 93.89 83.38 89.05 81.88 81.72 75.15 74.21 78.63 77.62 84.8 87.09 92.32 (65) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Total agins (see Table 5 and 5a): Water Main Apr May Jun Jul Aug Sep Oct Nov Dec (66) (66)me 144.94<	Heat g	ains fro	m water	heating	, kWł	n/month	0.2	5 í	[0.85	× (45)m	+ (6	1)m	ı] + 0.8 x	c [(46	6)m	+ (57)m	+ (5	9)m]	
Include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Internal gains (caee Table 5). Wates Metabolic gains (Table 5). Wates (60)m = $\begin{bmatrix} 144.94 \\ 144.94 $	(65)m=	93.89	83.38	89.05	81.	38 81	.72	7	5.15	74.21	78.	63	77.62	84	.8	87.09	92.3	32		(65)
5. Internal gains (see Table 5). Watts Jan Feb Mar Apr May Jun Jun Aug Sep Oct Nov Dec (66)m= 144.94 1	inclu	ide (57)	m in calo	culation	of (6	5)m only	/ if c	ylin	der is	s in the c	dwell	ing	or hot w	ater	is f	rom com	muni	ity h	eating	
$ \begin{array}{ccccc} detabolic qains (Table 5), Watts \\ \mbox{detabolic qains (Calculated in Appendix L, equation L9 or L9a), also see Table 5 \\ \mbox{detabolic qains (Calculated in Appendix L, equation L13 or L13a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L13 or L13a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L13 or L13a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L15 or L15a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L15 or L15a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L15 or L15a), also see Table 5 \\ \mbox{detabolic qains (calculated in Appendix L, equation L15 or L15a), also see Table 5 \\ \mbox{detabolic qains (Table 5a) \\ \mbox{detabolic qains (Table 5b) \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \mbox{detabolic qains are calculated using solar flux from Table 6a and associated equations to convert to th$	5. Int	ternal g	ains (see	Table	5 and	5a):														
$ \begin{array}{ c c c c c c } \hline \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Metab	olic gair	ns (Table	5) Wa	tte															
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	motab	Jan	Feb	Mar		or M	1ay		Jun	Jul	A	ug	Sep	С	Oct	Nov	D	ec		
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (67) m 48.49 43.07 35.03 26.52 19.82 16.73 18.08 23.5 31.55 40.06 46.75 49.84 (67) Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68) m 319.93 323.25 314.88 297.07 274.59 253.46 239.34 230.02 244.39 26.22 284.68 305.81 (68) Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69) m 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 (70) m 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(66)m=	144.94	144.94	144.94	144	94 144	.94	14	4.94	144.94	144	.94	144.94	144	.94	144.94	144	.94		(66)
	Liahtin	a aains	(calcula	ted in A	ppen	dix L. ed	nuati	on	L9 or	[.] L9a), a	lso s	ee T	Table 5							
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68) = $319.33 323.25 314.88 297.07 274.59 253.46 239.34 236.02 244.39 262.2 284.68 305.81 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 (69) = 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91(69) Pumps and fans gains (Table 5a)(70) • 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0$	(67)m=	48.49	43.07	35.03	26.	52 19	.82	1	6.73	18.08	23.	.5	31.55	40.	.06	46.75	49.8	84		(67)
$ \begin{array}{c} \text{(a)} \text{m} & 3 \text{ (b)} (b)$	Applia	L	ins (calc	ulated i	n Apr	endix I	ea	uat	ion I 1	13 or l 1	3a) ;	also	see Tal	ble 5	5					
Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated in Appendix L, equation L15 or L15a) also see Table 5 Cooking gains (calculated uses) (calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Core Calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. FF Gains (W) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 e3.91 (76) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 e3.91 (76) East 0.9x 0.54 x	(68)m=	319.93	323.25	314.88	297	07 274	, 0 9	25	3.46	239.34	236	.02	244.39	26	2.2	284.68	305	.81		(68)
Counting gains (calculated in popertux 2, equation 1215 of 2104) and one rable 3 (69) m $51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 51.91 (70) The set of 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 $	Cookir			ited in /	nnen		quat	ion	1 15	or 15a)	ale	0.56	Table	5						
Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2"C	(69)m-	51 91	51 91	51 91	51		91	5	1 91	51 91	51	91	51 91	51	91	51 91	51.0	91		(69)
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Dump	and fo		(Table	50)			Ŭ			01.	<u> </u>	01.01		.01	01.01	01.	01		()
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	(70)m-				5a)				0	0	0		0		<u> </u>	0	0	1		(70)
Losses e.g. evaporation (negative values) (Table 5) (71)m = $\frac{-96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63} -\frac{96.63}{-96.63}$ (71) Water heating gains (Table 5) (72)m = $\frac{126.2}{124.08} \frac{119.69}{119.69} \frac{113.72}{109.84} \frac{104.38}{104.38} \frac{99.74}{99.74} \frac{105.69}{107.8} \frac{107.8}{113.98} \frac{120.96}{124.09}$ (72) Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m = $\frac{594.84}{590.62} \frac{599.82}{597.53} \frac{504.48}{504.48} \frac{474.8}{457.39} \frac{465.44}{483.96} \frac{483.96}{516.46} \frac{552.62}{52.62} \frac{579.97}{57.97}$ (73) 6. Solar gains Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux g_{-} FF Gains Table 6b Table 6c (W) East $0.9x 0.54 \times 11.1 \times 19.64 \times 0.5 \times 0.8 = \frac{42.38}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times \frac{63.27}{11.1} \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 113.09 \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 113.09 \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 0.5 \times 0.8 = \frac{136.53}{10.63} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 0.57 \times 0.5 \times 0.8 = \frac{244.04}{10.6} (76)$ East $0.9x 0.54 \times 11.1 \times 111.1 \times 115.77 \times 0.5 \times 0.8 = \frac{244.04}{10.6} (76)$ East $0.9x 0.54 \times 11.1 \times 111.0 \times 0.5 \times 0.8 = \frac{244.04}{10.6} (76)$ East $0.9x 0.54 \times 11.1 \times 111.0 \times 0.5 \times 0.8 = \frac{249.81}{10.6} (76)$ East $0.9x 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = \frac{237.83}{10.6} (76)$ East $0.9x 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = \frac{237.83}{10.6} (76)$ East $0.9x 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = \frac{237.83}{10.6} (76)$ East $0.9x 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = \frac{237.83}{1$							/ T = h		-\		0	,	Ū			Ū	0	,		(10)
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Losses			n (nega		alues) ($\frac{(c)}{(c)}$	06.62	00	60	06.62	00	60	06.62	00	60	I	(71)
Water heating gains (1able 5) (72)me 126.2 124.08 119.69 113.72 109.84 104.38 99.74 105.69 107.8 113.98 120.96 124.09 (72) Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)me 594.84 590.62 569.82 537.53 504.48 457.39 465.44 483.96 516.46 552.62 579.97 (73) 6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux 9 0.5 x 0.8 = 42.38 (76) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 42.38 (76) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 136.53 (76) East 0.9x 0.54 x 11.1 x 132.7 x<	(71)m=	-90.03	-90.03	-90.03	-96	03 -90	.03	-9	0.03	-90.03	-90.	.03	-90.03	-90	0.03	-90.03	-90.	.03		(71)
$ \begin{array}{c} (72) \text{m} = & 126.2 & 124.08 & 119.69 & 113.72 & 109.84 & 104.38 & 99.74 & 105.69 & 107.8 & 113.98 & 120.96 & 124.09 & (72) \\ \hline \text{Total internal gains = } & (66) \text{m} + (67) \text{m} + (68) \text{m} + (69) \text{m} + (70) \text{m} + (71) \text{m} + (72) \text{m} \\ \hline (73) \text{m} = & 594.84 & 590.62 & 569.82 & 537.53 & 504.48 & 474.8 & 457.39 & 465.44 & 483.96 & 516.46 & 552.62 & 579.97 & (73) \\ \hline \text{G. Solar gains} \\ \hline \text{G. Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. \\ \hline \text{Orientation: Access Factor Table 6d m2 Table 6a and associated equations to convert to the applicable orientation. \\ \hline \text{Gains Table 6d m2 Table 6a and associated equations to convert to the applicable orientation. \\ \hline \text{Gains Table 6d m2 Table 6a Table 6b Table 6b G (W) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 19.64 \times 0.5 \times 0.8 = 42.38 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 92.28 \times 0.5 \times 0.8 = 136.53 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 113.09 \times 0.5 \times 0.8 = 199.13 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 113.09 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 113.09 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 115.77 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 115.77 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 115.77 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 115.77 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 115.77 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 11.1 \times 115.77 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = 244.04 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = 237.83 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 11.1 \times 110.22 \times 0.5 \times 0.8 = 237.83 (76) \\ \hline \text{East } 0.9 \times 0.54 \times 111.1 \times 110.22 \times 0.5 \times 0.8 = 237.8$	Water	heating	gains (1	able 5)	<u> </u>								107.0						I	(70)
Total internal gains = (66)m + (67)m + (68)m + (70)m + (71)m + (72)m (73)m= 594.84 590.62 597.53 504.48 474.8 457.39 465.44 483.96 516.46 552.62 579.97 (73) 6. Solar gains Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Table 6d Area Table 6a Flux g_ fable 6b FF Gains (W) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 42.38 (76) East 0.9x 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 136.53 (76) East 0.9x 0.54 x 11.1 x 13.09 x 0.5 x 0.8 = 136.53 (76) East 0.9x 0.54 x 11.1 x	(72)m=	126.2	124.08	119.69	113	72 109	9.84	10	.38	99.74	105	.69	107.8	113	3.98	120.96	124	.09		(72)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Total i	nternal	gains =		1				(66)	m + (67)m	1 + (68	3)m +	- (69)m + ((70)m	1 + (1	(1)m + (72)	m		l	(70)
6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Table 6d Area m ² Flux Table 6a g_{-} FF Table 6b Table 6c (W) East $0.9x$ 0.54 x 11.1 x 19.64 x 0.5 x 0.8 $=$ 42.38 (76) East $0.9x$ 0.54 x 11.1 x 38.42 x 0.5 x 0.8 $=$ 42.38 (76) East $0.9x$ 0.54 x 11.1 x 38.42 x 0.5 x 0.8 $=$ 42.38 (76) East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 $=$ 136.53 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 $=$ 244.04 (76) x 19.3	(73)m=	594.84	590.62	569.82	537	53 504	.48	4	74.8	457.39	465	.44	483.96	516	5.46	552.62	579.	.97		(73)
Orientation:Access Factor Table 6dArea m²Flux Table 6a g_{-} Table 6bFF Table 6cGains (W)East0.9x0.54x11.1x19.64x0.5x0.8=42.38(76)East0.9x0.54x11.1x38.42x0.5x0.8=42.38(76)East0.9x0.54x11.1x63.27x0.5x0.8=82.91(76)East0.9x0.54x11.1x63.27x0.5x0.8=199.13(76)East0.9x0.54x11.1x113.09x0.5x0.8=199.13(76)East0.9x0.54x11.1x115.77x0.5x0.8=244.04(76)East0.9x0.54x11.1x115.77x0.5x0.8=249.81(76)East0.9x0.54x11.1x110.22x0.5x0.8=237.83(76)East0.9x0.54x11.1x110.22x0.5x0.8=237.83(76)East0.9x0.54x11.1x110.22x0.5x0.8=237.83(76)East0.9x0.54x11.1x <t< td=""><td>6. SO</td><td>lar gain:</td><td>S:</td><td></td><td>or flux i</td><td>rom Tobl</td><td>. 60</td><td>and</td><td>00000</td><td>atad aqua</td><td>tiona</td><td>to oo</td><td>nuart to th</td><td></td><td></td><td>ble orientet</td><td>ion</td><td></td><td></td><td></td></t<>	6. SO	lar gain:	S:		or flux i	rom Tobl	. 60	and	00000	atad aqua	tiona	to oo	nuart to th			ble orientet	ion			
Contentation:Access FactorAreaFlux g_{-} Flux g_{-} Flux g_{-} Flux g_{-}				asing soi		roo	e 0a a	anu	Elur	aleu equa	10115			e app	Jiica		1011.		Caine	
East $0.9x$ 0.54 x 11.1 x 19.64 x 0.5 x 0.8 = 42.38 (76) East $0.9x$ 0.54 x 11.1 x 38.42 x 0.5 x 0.8 = 82.91 (76) East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 = 136.53 (76) East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 = 136.53 (76) East $0.9x$ 0.54 x 11.1 x 92.28 x 0.5 x 0.8 = 199.13 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 111.1 x 94.68 x 0.5 x 0.8 = 204.3 (76)	Unenta	-	Table 6d	acioi	A	n²			Tab	x ble 6a		Т	g_ able 6b		Т	able 6c			(W)	
East $0.9x$ 0.54 x 11.1 x 38.42 x 0.5 x 0.8 = 82.91 (76) East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 = 136.53 (76) East $0.9x$ 0.54 x 11.1 x 92.28 x 0.5 x 0.8 = 199.13 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 11.1 x 94.68 x 0.5 x 0.8 = 204.3 (76)	East	0.9x	0.54)	(11.1		x [1	9.64	x		0.5	;	× [0.8		=	42.38	(76)
East $0.9x$ 0.54 x 11.1 x 63.27 x 0.5 x 0.8 = 136.53 (76) East $0.9x$ 0.54 x 11.1 x 92.28 x 0.5 x 0.8 = 199.13 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 11.1 x 94.68 x 0.5 x 0.8 = 204.3 (76)	East	0.9x	0.54)	(11.1		× [3	8.42	x		0.5] :	×Ē	0.8		=	82.91	(76)
East $0.9x$ 0.54 x 11.1 x 92.28 x 0.5 x 0.8 = 199.13 (76) East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 11.1 x 94.68 x 0.5 x 0.8 = 204.3 (76)	East	0.9x	0.54	,	· 🕅	11.1		× [6	3.27	x		0.5	;	×Ē	0.8		=	136.53	(76)
East $0.9x$ 0.54 x 11.1 x 113.09 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 244.04 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 111.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 111.1 x 94.68 x 0.55 x 0.8 = 204.3 (76)	East	0.9x	0.54	,	·	11.1		×Ī	9	2.28	x		0.5	Ξ,	×Ē	0.8		=	199.13	(76)
East $0.9x$ 0.54 x 11.1 x 115.77 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 249.81 (76) East $0.9x$ 0.54 x 111.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 111.1 x 94.68 x 0.55 x 0.8 = 204.3 (76)	East	0.9x	0.54	,		11.1	Ħ	x [11	13.09	x	-	0.5	Ξ,	×Г	0.8		=	244.04	(76)
East $0.9x$ 0.54 x 11.1 x 110.22 x 0.5 x 0.8 = 237.83 (76) East $0.9x$ 0.54 x 11.1 x 94.68 x 0.5 x 0.8 = 237.83 (76)	East	0.9x	0.54	,		11.1	Ħ	x [11	15.77	x		0.5	٦,	×Г	0.8		=	249.81	(76)
East $0.9x$ 0.54 x 11.1 x 04.68 x 0.5 x 0.8 = 204.3 (76)	East	0.9x	0.54	,		11.1	Ħ	x [11	10.22	x		0.5	٦,	×Г	0.8	╡	=	237.83	(76)
	East	0.9x	0.54	,		11.1	Ē	×	9.	4.68	x		0.5	: ۲	×Ē	0.8		=	204.3	(76)

East	0.9x	0.54	×	11.1	x	73.59	x	0.5	×	0.8	=	158.79	(76)
East	0.9x	0.54	×	11.1	×	45.59] × [0.5	×	0.8	=	98.37	(76)
East	0.9x	0.54	×	11.1	x	24.49	×	0.5	×	0.8	=	52.84	(76)
East	0.9x	0.54	×	11.1	×	16.15) × [0.5	×	0.8	=	34.85	(76)
West	0.9x	0.77	×	5.6	×	19.64] × [0.5	×	0.8	=	30.49	(80)
West	0.9x	0.77	×	5.6	×	38.42] × [0.5	×	0.8	=	59.64	(80)
West	0.9x	0.77	x	5.6	×	63.27] × [0.5	×	0.8	=	98.22	(80)
West	0.9x	0.77	×	5.6	×	92.28] × [0.5	×	0.8	=	143.25	(80)
West	0.9x	0.77	×	5.6	×	113.09] × [0.5	×	0.8	=	175.56	(80)
West	0.9x	0.77	×	5.6	×	115.77] × [0.5	×	0.8	=	179.71	(80)
West	0.9x	0.77	×	5.6	×	110.22] × [0.5	×	0.8	=	171.09	(80)
West	0.9x	0.77	x	5.6	×	94.68] × [0.5	×	0.8	=	146.97	(80)
West	0.9x	0.77	x	5.6	×	73.59) × [0.5	×	0.8	=	114.23	(80)
West	0.9x	0.77	x	5.6	x	45.59	×	0.5	×	0.8	=	70.77	(80)
West	0.9x	0.77	x	5.6	x	24.49	x	0.5	x	0.8	=	38.01	(80)
West	0.9x	0.77	×	5.6	x	16.15	x	0.5	×	0.8	=	25.07	(80)
Solar	gains in	watts, calcu	lated	for each mon	th		(83)m =	Sum(74)m	. <mark>(8</mark> 2)m			1	
(83)m=	72.87	142.55 23	4.75	342.37 419.5	9 4	29.53 408.93	351.26	273.03	169.14	4 90.86	59.92		(83)
Total	gains – ii	nternal and	solar	(84)m = (73)n	1 + (83)m , watts				_			(5.1)
(84)m=	667.71	733.17 80	4.58	879.9 924.0	7 9	04.33 866.32	816.7	756.99	685.6	643.48	639.89		(84)
7. Me	ean <mark>inter</mark>	nal tempera	ature (heating seaso	on)								
7. Me Tem	ean inter perature	nal tempera during heat	ature (ting pe	heating seaso eriods in the li	on) ving	area from Ta	ble 9, T	⁻ h1 (°C)				21	(85)
7. Me Tem Utilis	ean inter perature ation fac	nal tempera during heat stor for gains	ature (ting pe s for li	heating seaso eriods in the li ving area, h1,	on) ving m (s	area from Ta ee Table 9a)	ble 9, T	⁻ h1 (°C)				21	(85)
7. Me Tem Utilis	ean inter perature ation fac Jan	nal tempera during heat tor for gains Feb	ature (ting pa s for li Mar	heating seaso eriods in the li ving area, h1, Apr Ma	on) ving m (s	area from Ta ee Table 9a) Jun Jul	ble 9, T Aug	h1 (°C) J Sep	Oct	Nov	Dec	21	(85)
7. Me Tem Utilis (86)m=	ean inter perature ation fac Jan 0.83	nal tempera during heat stor for gains Feb f 0.77 0	ature (ting pe s for li Mar .67	heating seaso eriods in the li ving area, h1, Apr Ma 0.53 0.4	on) ving m (s	area from Ta ee Table 9a) Jun Jul 0.28 0.2	ble 9, T Aug 0.22	Th1 (°C) Sep 0.36	Oct 0.58	Nov 0.76	Dec 0.84	21	(85)
7. Ma Temp Utilis (86)m= Mear	ean inter perature ation fac Jan 0.83	nal tempera during heat tor for gains Feb I 0.77 0 I temperatu	ture (ting pe s for li Mar .67 re in li	heating seaso priods in the li ving area, h1, Apr May 0.53 0.4 iving area T1	on) ving m (s y (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to	ble 9, T Aug 0.22 7 in Tal	Th1 (°C) g Sep 0.36 ole 9c)	Oct 0.58	Nov 0.76	Dec 0.84	21	(85)
7. Ma Tem Utilis (86)m= Mear (87)m=	ean inter perature ation fac Jan 0.83 n interna 20.63	nal tempera during heat stor for gains Feb I 0.77 0 I temperatur 20.74 20	ture (ing po s for li Mar .67 re in li 0.87	heating seaso eriods in the living area, h1, Apr May 0.53 0.4 iving area T1 20.96 20.99	on) ving m (s y (follo	area from Taee Table 9a)JunJul0.280.2ow steps 3 to2121	ble 9, T Aug 0.22 7 in Tal 21	Th1 (°C) Sep 0.36 ole 9c) 21	Oct 0.58 20.95	Nov 0.76	Dec 0.84 20.59	21	(85) (86) (87)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp	ean inter perature ation fac Jan 0.83 n interna 20.63 perature	nal tempera during heat stor for gains Feb I 0.77 0 I temperatu 20.74 20 during heat	iture (ting pe s for li Mar 67 re in li 0.87	heating seaso eriods in the living area, h1, Apr May 0.53 0.4 iving area T1 20.96 20.99 eriods in rest o	on) ving m (s y (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta	ble 9, T Aug 0.22 7 in Tal 21 able 9,	Th1 (°C) Sep 0.36 ble 9c) 21 Th2 (°C)	Oct 0.58 20.95	Nov 0.76 20.79	Dec 0.84 20.59	21	(85) (86) (87)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5	nal temperativeduring heatctor for gainsFeb0.7701 temperature20.7420.7420.52	iture (ting pe s for li Mar .67 re in li 0.87 ting pe 0.5	heating seaseeriods in the lingving area, h1,AprMay0.530.4iving area T120.9620.99eriods in rest of20.5120.51	on) ving m (s v (follo of dw	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta 20.51 20.51	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51	Th1 (°C) 9 Sep 0.36 oble 9c) 21 Th2 (°C) 20.51	Oct 0.58 20.95 20.51	Nov 0.76 20.79 20.51	Dec 0.84 20.59 20.5	21	(85) (86) (87) (88)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac	nal temperationduring heatctor for gainsFebI0.770I temperature20.7420during heat20.52ctor for gains	ture (ting pe s for li Mar .67 re in li 0.87 ting pe 0.5	heating seaso eriods in the living area, h1, Apr May 0.53 0.4 iving area T1 20.96 20.99 eriods in rest of 20.51 20.51 est of dwelling	n) ving m (s / (follc (follc	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta 20.51 20.51 ,m (see Table	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 29a)	Th1 (°C) Sep 0.36 ole 9c) 21 Th2 (°C) 20.51	Oct 0.58 20.95 20.51	Nov 0.76 20.79 20.51	Dec 0.84 20.59 20.5	21 	(85) (86) (87) (88)
7. Ma Temp Utilis (86)m= Mear (87)m= Temp (88)m= Utilis (89)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81	nal temperativeduring heatctor for gainsFeb0.770.771 temperatu20.7420.7420.52ctor for gains0.750	ture (ting pe s for li Mar .67 re in li 0.87 ting pe 0.5 s for re	heating seaseeriods in the lingving area, h1,AprMay0.530.4iving area20.9620.9620.9620.5120.5120.510.510.53	ving m (s y (follc j, h2	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta 20.51 20.51 ,m (see Table 0.26 0.18	ble 9, 7 Aug 0.22 7 in Tal 21 able 9, 20.51 9a) 0.2	Th1 (°C) 9 Sep 0.36 ole 9c) 21 Th2 (°C) 20.51	Oct 0.58 20.95 20.51	Nov 0.76 20.79 20.51	Dec 0.84 20.59 20.5	21]]	(85) (86) (87) (88) (88)
7. Ma Temp Utilis (86)m= Meau (87)m= Temp (88)m= Utilis (89)m= Meau	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81	nal temperative during heat ctor for gains Feb I 0.77 0 I temperature 20 during heat 20 during heat 20 ctor for gains 0 0.75 0	iture (ing pe s for li Mar .67 re in li 0.87 ting pe 0.5 s for re .66	heating seaso eriods in the living area, h1, Apr May 0.53 0.4 iving area T1 20.96 20.99 eriods in rest of 20.51 20.51 est of dwelling 0.51 0.38	y (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta 20.51 20.51 ,m (see Table 0.26 0.18	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 9 9a) 0.2 0.2	Th1 (°C) 9 Sep 0.36 ole 9c) 21 Th2 (°C) 20.51 0.33 0.7 in Table	Oct 0.58 20.95 20.51 0.56	Nov 0.76 20.79 20.51 0.74	Dec 0.84 20.59 20.5 0.83	21 	(85) (86) (87) (88) (89)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20	nal temperation during heat ctor for gains Feb I 0.77 0 I temperature 20.74 20.74 20 during heat 20.5 20.5 2 ctor for gains 0.75 0.75 0 I temperature 20.16	ture (ting pe s for li Mar .67 re in li 0.87 ting pe 0.5 s for ro .66 re in t	heating seaseeriods in the living area, h1,AprMay0.530.40.530.4iving area T120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwe20.4520.5	ying m (s y (follo y g, h2 y y	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta 20.51 20.51 ,m (see Table 0.26 0.18 1 T2 (follow str 20.51 20.51	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 eps 3 to 20.51	Th1 (°C) Sep 0.36 0.36 0le 9c) 21 Th2 (°C) 20.51 0.33 0.7 in Table 20.51	Oct 0.58 20.95 20.51 0.56 20.51	Nov 0.76 20.79 20.51 0.74 20.24	Dec 0.84 20.59 20.5 0.83 19.96	21	(85) (86) (87) (88) (89) (90)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20	nal temperaturing heatduring heatctor for gainsFeb0.770.771 temperaturing heat20.7420.52ctor for gains0.7501 temperaturing20.1620.16	ture (ting pe s for li Mar .67 re in li 0.87 ting pe 0.5 s for re .66 re in t 0.33	heating seaseeriods in the lipving area, h1,AprMay0.530.4iving areaT120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwe20.4520.5	on) ving m (s y (follc (follc), h2), h2)), h2),	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta 20.51 20.51 ,m (see Table 0.26 0.18 1 T2 (follow str 20.51 20.51	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 e 9a) 0.2 eps 3 to 20.51	Th1 (°C) 9 Sep 0.36 0.36 21 Th2 (°C) 20.51 0.33 07 in Table 20.51	Oct 0.58 20.95 20.51 0.56 9 9 c) 20.45 A = Liv	Nov 0.76 20.79 20.51 0.74 20.24	Dec 0.84 20.59 20.5 0.83 19.96	0.58	(85) (86) (87) (88) (89) (90) (91)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20	nal temperative during heat ctor for gains Feb I 0.77 0 I temperature 20 during heat 20 ctor for gains 0 0.75 0 I temperature 20.75 0.75 0 I temperature 20.16 20.16 20	ture (ting pe s for li Mar .67 re in li 0.87 ting pe 0.5 s for re .66 re in t 0.33	heating seaseeriods in the living area, h1,AprMay0.530.4iving area T120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwell20.4520.51	on) ving m (s y (follo (follo) (follo)) (follo)	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta 20.51 20.51 wow (see Table 0.26 0.18 0.26 0.18 0.27 20.51 velling from Ta 20.51 0.26 0.18 0.26 0.18 0.26 0.18 0.26 0.18	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 99a) 0.2 eps 3 to 20.51	Th1 (°C) Sep 0.36 0.36 0le 9c) 21 Th2 (°C) 20.51 0.33 0 7 in Table 20.51 ft	Oct 0.58 20.95 20.51 0.56 20.56 20.45 20.45 A = Liv	Nov 0.76 20.79 20.51 0.74 20.24 ving area ÷ (4)	Dec 0.84 20.59 20.5 0.83 19.96 4) =	0.58	(85) (86) (87) (88) (89) (90) (91)
7. Ma Temp Utilis (86)m= Mear (87)m= Temp (88)m= Utilis (89)m= Mear (90)m= Mear (92)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20	nal temperative during heat ctor for gains Feb I 0.77 0 I temperature 20.74 20 during heat 20.5 2 ctor for gains 0.75 0 I temperature 20.16 20 I temperature 20.16 20 I temperature 20.49 20	ture (ting points for line Mar .67 re in line .67 ting points .66 re in t 0.33 re (for	heating seaseeriods in the lingving area, h1,AprMay0.530.4iving areaT120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwelling20.4520.5	ving m (s y (follc bf dw y y, h2 y, h2 y, h2 y, h2	area from Taee Table 9a)JunJul0.280.2ow steps 3 to2121velling from Ta20.5120.51,m (see Table0.260.181 T2 (follow str20.5120.51(see Table0.260.181 T2 (follow str20.5120.51	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 9 9a) 0.2 eps 3 to 20.51 + (1 –	Th1 (°C) 9 Sep 0.36 0.36 21 Th2 (°C) 20.51 0.33 0 7 in Table 20.51 fLA) × T2 20.79	Oct 0.58 20.95 20.51 0.56 9C) 20.45 A = Liv	Nov 0.76 20.79 20.51 0.74 20.24 ring area ÷ (4	Dec 0.84 20.59 20.5 0.83 19.96 4) =	21 21 0.58	(85) (86) (87) (88) (89) (90) (91)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m= Mean (90)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20 n interna 20 n interna	nal temperaturing heat during heat itor for gains Feb I 0.77 0 I temperaturing heat 20.74 20 during heat 20.74 20 during heat 20.75 0 I temperaturing 20.16 20.16 20 I temperaturing 20.16 20.49 20 Depend to the state 20	ture (ting po s for li Mar .67 re in li 0.87 ting po 0.5 s for re .66 re in t 0.33 re (for 0.64	heating seaseeriods in the living area, h1,AprMay0.530.4iving area T120.9620.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwelling20.4520.51the whole dw20.7520.78	y ving (follo (follo (follo) velling velling velling	area from Taaee Table 9a)JunJul0.280.2ow steps 3 to2121velling from Ta20.5120.51,m (see Table0.260.181 T2 (follow str20.5120.51(g) = fLA × T120.7920.79ure from Table	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 99a) 0.2 eps 3 to 20.51 + (1 – 20.8 4 o with	Th1 (°C) J Sep 0.36 ole 9c) 21 Th2 (°C) 20.51 0.33 o 7 in Table 20.51 fLA) x T2 20.79	Oct 0.58 20.95 20.51 0.56 20.45 20.45 A = Liv 20.74	Nov 0.76 20.79 20.51 0.74 20.24 ring area ÷ (4) 20.56	Dec 0.84 20.59 20.5 0.83 19.96 4) = 20.33	21 21 0.58	(85) (86) (87) (88) (89) (90) (91) (92)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m= Mean (92)m= Apply (93)m=	an inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20 n interna 20.36 y adjustn 20.36	nal temperation during heat ctor for gains Feb I 0.77 0 I temperature 20 20.74 20 during heat 20 20.74 20 during heat 20 20.75 0 I temperature 20 1 temperature 20 1 temperature 20 1 temperature 20 1 temperature 20 20.16 20 1 temperature 20 20.49 20	iture (ing person s for li Mar .67 re in li 0.87 ing person 0.5 s for re .66 re in t 0.33 re (for 0.64 mean 0.64	heating seaseeriods in the living area, h1,AprMay0.530.4iving area T120.9620.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwell20.4520.5the whole dw20.7520.78internal temp20.7520.78	ving m (s (follo) (follo) (follo)) (follo)) (follo)) (follo)) (follo)) (follo)) (follo))) (follo)))) (follo))))) (follo))))) (follo))))))))))))))))))	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 21 21 velling from Ta 20.51 20.51 velling from Ta 0.26 0.18 0.26 0.18 0.26 0.18 1 T2 (follow str 20.51 20.51 20.51 20.51 are from Table 20.79 20.79	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 9 9a) 0.2 eps 3 to 20.51 + (1 – 20.8 + (20.8)	Th1 (°C) Sep 0.36 0.36 0.36 0.36 21 Th2 (°C) 20.51 0.33 07 in Table 20.51 fLA) × T2 20.79 here appro 20.79	Oct 0.58 20.95 20.51 0.56 20.45 20.45 A = Liv 20.74 priate 20.74	Nov 0.76 20.79 20.51 0.74 20.24 zing area ÷ (2 20.56	Dec 0.84 20.59 20.5 0.83 19.96 4) = 20.33	21 21 0.58	(85) (86) (87) (88) (89) (90) (91) (92) (93)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m= Mean (92)m= Apply (93)m=	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20 n interna 20 n interna 20 ation fac 0.81 n interna 20 ation fac 0.81 n interna	nal temperaturing heat during heat ctor for gains Feb I 0.77 0 I temperaturing heat 20.74 20 during heat 20.5 ctor for gains 0.75 0.75 0 I temperaturi 20.16 20.16 20 I temperaturi 20.20 nent to the r 20.49 20.49 20 nent to the r 20.49	ture (ting pe s for li Mar .67 re in li 0.87 ting pe 0.5 s for re .66 re in t 0.33 re (for 0.64 mean 0.64 ment	heating seaseeriods in the lingving area, h1,AprMay0.530.4iving areaT120.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwelling20.4520.5the whole dw20.7520.78internal tempo20.7520.78	on) ving m (s y (follc (follc) y y i i i i i i i i i i i i i	area from Taee Table 9a)JunJunJunJun0.280.2ow steps 3 to21212121212121212121212121212121212120.5120.5120.5120.5120.5120.7920.7920.7920.7920.7920.7920.79	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 e 9a) 0.2 eps 3 to 20.51 + (1 – 20.8 e 4e, wl 20.8	Th1 (°C) 9 Sep 0.36 ole 9c) 21 Th2 (°C) 20.51 0.33 o 7 in Table 20.51 fLA) × T2 20.79 here appro 20.79	Oct 0.58 20.95 20.51 0.56 9 9c) 20.45 A = Liv 20.74 priate 20.74	Nov 0.76 20.79 20.51 0.74 20.24 ving area ÷ (4 20.56	Dec 0.84 20.59 20.5 20.5 19.96 4) = 20.33 20.33	21 21 0.58	(85) (86) (87) (88) (89) (90) (91) (91) (92) (93)
7. Ma Temp Utilis (86)m= Mean (87)m= Temp (88)m= Utilis (89)m= Mean (90)m= Mean (90)m= Mean (92)m= Apply (93)m= 8. Sp Set T	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20 n interna 20.36 y adjustn 20.36 y adjustn 20.36	nal temperation during heat ctor for gains Feb I 0.77 0 I temperature 20 20.74 20 during heat 20 during heat 20 ctor for gains 0.75 0.75 0 I temperature 20.16 20.16 20 I temperature 20.49 20.49 20 nent to the r 20.49 20.49 20 mean intern 20.49	iture (ing pe s for li Mar .67 re in li 0.87 .66 s for re .66 re in t 0.33 re (for 0.64 mean 0.64 mean 0.64 mean 0.64	heating seaseeriods in the living area, h1,AprMay0.530.4iving area T120.9620.9620.99eriods in rest of20.5120.51est of dwelling0.510.38he rest of dwelling20.4520.5the whole dw20.7520.78internal tempo20.7520.78	innec	area from Taarea Table 9a)JunJul0.280.2ow steps 3 to2121velling from Ta20.5120.51velling from Ta20.5120.51on (see Table0.260.180.260.180.260.180.27120.5120.5120.5120.5120.79ure from Table20.7920.79ure from Table20.7920.79d at step 11 of	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 e 9a) 0.2 eps 3 to 20.51 + (1 – 20.8 e 4e, wl 20.8 e 4e, wl	Th1 (°C) J Sep 0.36 ole 9c) 21 Th2 (°C) 20.51 0.33 0 7 in Table 20.51 fLA) × T2 20.79 nere appro 20.79 9b, so that	Oct 0.58 20.95 20.51 0.56 e 9c) 20.45 20.45 20.74 priate 20.74 priate 20.74	Nov 0.76 20.79 20.51 0.74 20.24 ring area ÷ (4 20.56 20.56 (76)m an	Dec 0.84 20.59 20.5 0.83 19.96 4) = 20.33 20.33 20.33	21 21	(85) (86) (87) (88) (89) (90) (91) (92) (93)
7. Ma Temp Utilis (86)m= Mear (87)m= Temp (88)m= Utilis (89)m= Mear (90)m= Mear (90)m= Mear (92)m= Apply (93)m= 8. Sp Set T the u	ean inter perature ation fac Jan 0.83 n interna 20.63 perature 20.5 ation fac 0.81 n interna 20 n interna 20.36 y adjustn 20.36 y adjustn 20.36 ri to the ri tilisation	nal temperature during heat ctor for gains Feb I 0.77 0 I temperature 20.74 20 during heat 20.5 2 ctor for gains 0.75 0 I temperature 20.16 20 1 temperature 20.16 20 I temperature 20.16 20 I temperature 20.49 20 I temperature 20.49 20 nent to the r 20.49 20 mean intern factor for g 10	ture (ting points for ling Mar 1.67 re in ling points for re 0.5 s for re 0.66 re in t 0.33 re (for 0.64 mean 0.64 mean 0.64 mean 0.64	heating sease eriods in the living area, h1, Apr May 0.53 0.4 iving area T1 20.96 20.96 20.99 eriods in rest of 20.51 20.51 est of dwelling 0.51 0.51 20.51 est of dwelling 0.51 20.45 20.5 the whole dw 20.75 20.78 internal tempo 20.75 20.78 internal tempo 20.75 20.78	innec	area from Taee Table 9a)JunJul0.280.2ow steps 3 to2121velling from Ta20.5120.51,m (see Table0.260.181 T2 (follow str20.5120.5120.5120.51eg) = fLA × T120.7920.79ure from Table20.7920.79at step 11 of	ble 9, T Aug 0.22 7 in Tal 21 able 9, 20.51 9a) 0.2 eps 3 to 20.51 + (1 – 20.8 e 4e, wl 20.8 e 4e, wl 20.8	Th1 (°C) 9 Sep 0.36 0.36 21 Th2 (°C) 20.51 0.33 0 7 in Table 20.51 fLA) × T2 20.79 here appro 20.79 9b, so that	Oct 0.58 20.95 20.51 0.56 9 9c) 20.45 20.45 20.74 priate 20.74 Ti,m=	Nov 0.76 20.79 20.51 0.74 20.24 ring area ÷ (4 20.56 20.56 (76)m an	Dec 0.84 20.59 20.5 0.83 19.96 4) = 20.33 20.33 d re-calc	21 21 0.58	(85) (86) (87) (88) (89) (90) (91) (91) (92) (93)

Utilisation factor for gains, hm:						
(94)m= 0.81 0.75 0.66 0.52 0.39 0.27 0.19 0.21	0.35	0.57	0.74	0.83		(94)
Useful gains, hmGm , W = (94)m x (84)m						
(95)m= 540.92 553.11 531.08 461.17 359.97 244.46 165.79 173.3	264.26	389.56	477.82	529.03		(95)
Monthly average external temperature from Table 8	-i			1	I	(0.0)
(96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm, $VV = [(39)m \times [(93)m \times $	m = (96)m	105.16	540.27	650 13		(97)
(37) = 033.04 032.39 372.42 474.44 302.39 244.00 103.00 173.5 Space beating requirement for each month kWh/month = 0.024 x [($\frac{203.04}{100}$	$\frac{1403.10}{5}$ ml x (4	1)m	030.13		(07)
(98)m= 83.42 53.41 30.76 9.56 2.25 0 0 0		11.6	44.97	90.1		
	otal per year	(kWh/yea	r) = Sum(9	8)15,912 =	326.06	(98)
Space heating requirement in kWh/m²/year					4.2	(99)
9b. Energy requirements – Community heating scheme						
This part is used for space heating, space cooling or water heating pr	ovided by	a comm	unity scł	neme.		_
Fraction of space heat from secondary/supplementary heating (Table	11) '0' if n	ione	-		0	(301)
Fraction of space heat from community system $1 - (301) =$					1	(302)
The community scheme may obtain heat from several sources. The procedure allows t	or CHP and	up to four	other heat	sources; t	he latter	_
includes boilers, heat pumps, geothermal and waste heat from power stations. See Ap	bendix C.				1	(303a)
Fraction of total anges best from Community heat nump		(2	00) x (202			
Fraction of total space near from Community near pump		()	UZ) X (303	a) =	1	(304a)
Factor for control and charging method (Table $4c(3)$) for community h	eating sys	stem			1	(305)
Distribution loss factor (Table 12c) for community heating system					1.05	(306)
Space heating Annual space heating requirement					kWh/year	1
Space heat from Community heat pump	(98) x (3	04a) x (30	5) x (306) :	=	342.36	 (307a)
Efficiency of secondary/supplementary heating system in % (from Tal	ole 4a or A	Appendix	E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (3	01) x 100 ·	÷ (308) =		0	(309)
Water heating						-
Annual water heating requirement					2091.65]
If DHW from community scheme: Water heat from Community heat pump	(64) x (3	03a) x (30	5) x (306) :	=	2196.24	(310a)
Electricity used for heat distribution 0.	01 × [(307a)	(307e) +	- (310a)((310e)] =	25.39	(313)
Cooling System Energy Efficiency Ratio					0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) -	÷ (314) =			0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outsic	le				250.5	_ (330a)
warm air heating system fans					0	_ (330b)
pump for solar water heating					0	(330g)
Total electricity for the above, kWh/year	=(330a)	+ (330b) +	(330g) =		250.5	(331)
	· · · · · ·					

Energy for lighting (calculated in A	Appendix L)			Γ	342.54	(332)
Electricity generated by PVs (App	endix M) (negative quan	tity)		Γ	-331.63	(333)
Electricity generated by wind turb	ine (Appendix M) (negati	ve quantity)		Ē	0	(334)
10b. Fuel costs – Community he	ating scheme					
	Fuel kWh/	year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a)	x	4.24 ×	0.01 =	14.52	(340a)
Water heating from CHP	(310a)	x	4.24 ×	0.01 =	93.12	(342a)
Pumps and fans	(331)		Fuel Price	0.01 =	22.04	7(240)
Energy for lighting	(332)		13.19	0.01 =	45.19	$]^{(3+3)}$
Additional standing charges (Tabl	() ()		13.19	Г	45.18	(350)
				L	120	
Energy saving/generation technol Item 1	ogies		13.19 ×	0.01 =	-43.74	(352)
Total energy cost	= (340a)(342e) + (3	345)(354) =		Γ	262.12	(355)
11b. SAP rating - Community he	ating scheme					
Energy cost deflator (Table 12)				Г	0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) +	+ 45.0] =			0.9	(357)
SAP rating (section12)					87.47	(358)
12b. CO2 Emissions – Communit	y heating scheme	_				
		Energy kWh/yea	r kg CO2/kV	factor E Vh k	missions g CO2/year	
CO2 from other sources of space Efficiency of heat source 1 (%)	and water heating (not C If there is CH	CHP) IP using two fuels repea	t (363) to (366) for the se	cond fuel	219	(367a)
CO2 associated with heat source	1 [(307b)+(310b)] x 100 ÷ (3	367b) x 0.52	=	601.61	(367)
Electrical energy for heat distribut	ion	[(313) x	0.52	=	13.18	(372)
Total CO2 associated with comm	unity systems	(363)(366) + (3	368)(372)	=	614.79	(373)
CO2 associated with space heating	ng (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from in	mmersion heater or insta	intaneous heater	(312) x 0.22	=	0	(375)
Total CO2 associated with space	and water heating	(373) + (374) + (3	375) =		614.79	(376)
CO2 associated with electricity for	r pumps and fans within	dwelling (331)) x	0.52	=	130.01	(378)
CO2 associated with electricity for	r lighting	(332))) x	0.52	=	177.78	(379)
Energy saving/generation technol Item 1	ogies (333) to (334) as a	pplicable	0.52 ×	0.01 =	-172.12	(380)
Total CO2, kg/year	sum of (376)(382) =	=		Γ	750.46	(383)
Dwelling CO2 Emission Ra	ate (383) ÷ (4) =			Ľ	9.67	(384)

13b. Primary Energy – Community heating scheme				
	Energy kWh/year	Primary factor	P.Energy kWh/year	
Energy from other sources of space and water heating (not CHI Efficiency of heat source 1 (%) If there is CHP using	>) g two fuels repeat (363) to (366) for the second	fuel 219	(367a)
Energy associated with heat source 1 [(307b)+	(310b)] x 100 ÷ (367b) x	3.07	= 3558.67	(367)
Electrical energy for heat distribution	[(313) x		= 77.93	(372)
Total Energy associated with community systems	(363)(366) + (368)(372)	= 3636.61	(373)
if it is negative set (373) to zero (unless specified otherwise, s	see C7 in Appendix C)	3636.61	(373)
Energy associated with space heating (secondary)	(309) x	0	= 0	(374)
Energy associated with water from immersion heater or instanta	aneous heater(312) x	1.22	= 0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =		3636.61	(376)
Energy associated with space cooling	(315) x	3.07	= 0	(377)
Energy associated with electricity for pumps and fans within dw	elling (331)) x	3.07	= 769.04	(378)
Energy associated with electricity for lighting	(332))) x	3.07	= 1051.61	(379)
Energy saving/generation technologies Item 1 Total Primary Energy, kWh/year sum of (376)	.(382) =	3.07 × 0.01	= <u>-1018.1</u> 4439.15	(380) (383)

			User D	etails:						
Assessor Name: Software Name:	Stroma FSA	P 2012		Stroma Softwa	a Num are Ver	ber: sion:		Versio	n: 1.0.4.18	
			Property .	Address:	08_s_n	ו				
Address :	BIOCK JKL, Ag	jar Grove, Ca	maen, Lo	ondon, N	W191B					
Ground floor	1510115.		Area	a(m²) 72.1	(1a) x	Av. He	ight(m)	(2a) =	Volume(m ² 227.12	³) (3a)
Total floor area TFA = (1a	a)+(1b)+(1c)+(1c	d)+(1e)+(1	n)	72.1	(4)			-		
Dwelling volume			L		(3a)+(3b)	+(3c)+(3c	d)+(3e)+	.(3n) =	227.12	(5)
2. Ventilation rate:										
Number of chimneys Number of open flues	main heating 0	seconda heating + 0 + 0	ry + +	0 0] = [] = [total 0 0		40 = 20 =	0 0	ur (6a) (6b)
Number of intermittent far				-		0	x /	10 =	0	(7a)
Number of passive vents						0		10 -	0	
Number of passive vents					Ļ	0		10 -	0	(70)
Number of flueless gas fir	es		7-) - (7-) - (0		Air ch	0 anges per he	(7c)
Infiltration due to chimney	s, flues and fan	S = (ba) + (bb) + (bb	(7a)+(7b)+((C) =	continue fr	0	(16)	÷ (5) =	0	(8)
Number of storeys in th Additional infiltration Structural infiltration: 0.	e dwelling (ns) 25 for steel or ti	mber frame o	r 0.35 foi	r masonr	v constr	uction	[/0) [(9)·	-1]x0.1 =	0	(9) (10) (11)
if both types of wall are pro deducting areas of openin	esent, use the value gs); if equal user 0.	e corresponding 35	to the great	er wall are	a (after			ı ı		
If suspended wooden it	oor, enter 0.2 (t	tor 0).1 (seale	ea), eise	enter U				0	(12)
Percentage of windows	and doors drau	ucht stripped							0	(13)
Window infiltration		ight stripped		0.25 - [0.2	x (14) ÷ 1	00] =			0	(15)
Infiltration rate				(8) + (10)	+ (11) + (1	2) + (13) ·	+ (15) =		0	(16)
Air permeability value, o	q50, expressed	in cubic metr	es per ho	our per so	quare m	etre of e	envelope	area	1	(17)
If based on air permeabili	ty value, then (1	8) = [(17) ÷ 20]+	(8), otherwi	ise (18) = (16)				0.05	(18)
Air permeability value applies	s if a pressurisation	test has been do	ne or a deg	gree air pei	meability	is being u	sed			_
Number of sides sheltered	b			(20) – 1	0 075 v (1	0)1			2	(19)
Shelter factor	na chaltar facta	-		(20) = 1 - 1	0.075 X (1	9)] =			0.85	(20)
Infiltration rate modified for	ng sheller lacto	anaad		(21) = (10)	x (20) =				0.04	(21)
		May lup		Δυσ	Son	Oct	Nov	Dec		
Monthly over go wind on	ad from Table		Jui	Aug	Oep	001		Dec		
$(22)m = \begin{bmatrix} 5.1 \\ 5 \end{bmatrix} = \begin{bmatrix} 5.1 \\ 5 \end{bmatrix}$		4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
			1 0.0							
Wind Factor (22a)m = (22 (22a)m = 1.27 1 25 1	2)m ÷ 4	1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		
					•		L			

Adjust	ed infiltr	ation rate	e (allow	ing for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m				_	
_	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.05		
Calcul	ate effe	ctive air	change	rate for t	he appli	cable ca	se				•	-	- 	
IT ME	ecnanica			" N (0		、 - (. (201)				0.5	(23a)
If exh	aust air h	eat pump (using App	endix N, (2	(23a) = (23a	a) × Fmv (e	equation (f	N5)), othei	rwise (23b)) = (23a)			0.5	(23b)
lf bala	anced with	heat reco	overy: effic	iency in %	allowing f	or in-use f	actor (from	n Table 4h)) =				76.5	(23c)
a) If	balance	d mecha	anical ve	entilation	with hea	at recove	ery (MVI	HR) (24a	a)m = (22	2b)m + (23b) × [1 – (23c) ÷ 100]	
(24a)m=	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17		(24a)
b) If	balance	d mecha	anical ve	entilation	without	heat rec	covery (N	MV) (24b)m = (22	2b)m + (2	23b)			
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If	whole h	ouse ex	tract ver	ntilation of	or positiv	ve input v	ventilatio	on from c	outside		-		-	
i	if (22b)n	n < 0.5 ×	(23b), t	then (24d	c) = (23b); otherv	wise (24	c) = (22b	o) m + 0.	5 × (23b)			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If	natural	ventilatio	on or wh	ole hous	se positiv	/e input	ventilatio	on from l	oft		•	-	-	
i	if (22b)n	n = 1, the	en (24d)	m = (22	o)m othe	erwise (2	4d)m =	0.5 + [(2	2b)m² x	0.5]	-	_	_	
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effe	ctive air	change	rate - er	nter (24a) or (24t	o) or (24	c) or (24	d) in box	< (25)					
(25)m=	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17		(25)
0.110	of losses												-	
3. He	at losse	s and ne	eat loss		er:									
ELEN		area	8S (m²)	Openin	gs 2	Net Ar	ea n²	U-vait W/m2	ue :K	A X U (W/I	()	K-Value	e / K k	ч х к «J/K
Windo		e 1				17.6		[1/(0.85)+	⊦ 0.041 _ [14 47				(27)
Windo		2				7.0		۲ [1/(0 85)]	⊦ 0 04) – [6.40	H			(27)
Welle -		, 2				7.9		[1/(0.00)]		6.49	H,			(27)
vvaiis	гурет	41		17.6		23.4		0.2		4.68	Цļ			(29)
Walls	Гуре2	18.9	9	7.9		11	x	0.2	=	2.2				(29)
Total a	rea of e	lements	, m²			59.9								(31)
* for win	dows and	roof winde	ows, use e	effective wi	ndow U-va	alue calcul	ated using	formula 1	/[(1/U-valu	e)+0.04] a	ns given in	paragrapi	h 3.2	
** includ	le the area	as on both	sides of in	nternal wal	ls and part	titions								
Fabric	heat los	ss, vv/K =	= S (A x	U)				(26)(30)) + (32) =				27.84	(33)
Heat c	apacity	Cm = S(Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	584.8	(34)
Therm	al mass	parame	ter (TMI	⁻ = Cm ÷	- TFA) ir	n kJ/m²K			Indica	tive Value	: Low		100	(35)
For desi	gn assess	sments wh	ere the de	etails of the	construct	ion are not	t known pr	ecisely the	e indicative	values of	TMP in Ta	able 1f		
Thorm	al brida			uiaiion. culatod i		nondix l							0.00	
if dotails	of thorm	55.3 (L	A I) Cal		- 0.05 v (2		X						8.99	(30)
Total f	abric he	at loss	are not ki	101111 (30) =	= 0.00 X (3	1)			(33) +	(36) =			36.83	(37)
Ventila	tion her	at loss ca	alculater	1 monthly					(38)m	$-0.33 \times ($	25)m x (5)		50.05	
Ventile		Eob	Mor			lun		Δυα	Son				1	
(20)~~	Jan 10.07	10.70	10.71	Api 10.01	10.00	14.02	Jui 11.02	Aug	3ep		10.00	12.55	-	(38)
(00)11=	12.07	12.19	12.71	12.31	12.20	11.00	11.03	11.70	11.99	12.20	12.39	12.00	J	(00)
Heat tr	ansfer o	coefficier	nt, W/K						(39)m	= (37) + (3	38)m		-	
(39)m=	49.69	49.62	49.54	49.14	49.06	48.66	48.66	48.58	48.82	49.06	49.22	49.38		
		motor /	יאי ים וב	/m21/					(40)	Average =	Sum(39) ₁	12 /12=	49.12	(39)
	ss para		ז∟ <i>רי</i>), עע		0.00	0.07	0.07	0.07	(40)m	= (39)m ÷	(4)	0.00	1	
(40)m=	0.69	0.69	0.69	0.68	0.68	0.67	0.67	0.67	0.68	0.68	0.68	0.68	0.55	
									/	verage =	Sum(40)1	12 /12=	0.68	(40)

Numbe	er of day	rs in moi	nth (Tab	le 1a)			-	-		-				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Wa	ater heat	ing enei	rgy requ	irement:								kWh/ye	ear:	
Assum if TF if TF	ned occu A > 13.9 A £ 13.9	ıpancy, l ∂, N = 1 ∂, N = 1	N + 1.76 x	[1 - exp	(-0.0003	49 x (TF	⁻ A -13.9)2)] + 0.(0013 x (⁻	TFA -13.	2 9)	.3		(42)
Annua Reduce	l averag the annua	e hot wa al average litres per l	ater usag hot water	ge in litre usage by r day (all w	es per da 5% if the d	y Vd,av	erage = designed i Id)	(25 x N) to achieve	+ 36 a water us	se target o	88 f	.73		(43)
	.lan	Feb	Mar	Apr	May	Jun		Αυσ	Sen	Oct	Nov	Dec		
Hot wate	er usage in	n litres per	day for ea	ach month	Vd,m = factor	ctor from T	Table 1c x	(43)	Cop	000		200		
(44)m=	97.6	94.05	90.5	86.96	83.41	79.86	79.86	83.41	86.96	90.5	94.05	97.6		_
Energy	content of	hot water	used - cal	culated me	onthly $= 4$.	190 x Vd,n	n x nm x D)))))))))))))))))))) kWh/mor	Total = Su oth (see Ta	m(44) ₁₁₂ = ables 1b, 1	c, 1d)	1064.76	(44)
(45)m=	144.74	126.59	130.63	113.89	109.28	94.3	87.38	100.27	101.47	118.25	129.08	140.18		
				1					-	Total = Su	m(45) ₁₁₂ =		1396.07	(45)
lf instan	taneous w	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46) to (61)					
(46)m= Water	21.71 storage	18.99 loss:	19.59	17.08	16.39	14.14	13.11	15.04	15.22	17.74	19.36	21.03		(46)
Storag	e volum	e (litres)	includir	ng any so	olar or W	WHRS	storage	within sa	ame ves	sel		0		(47)
If com	munity h	eating a	ind no ta	ink in dw	velling, e	nter 110	litres in	(47)						
Otherv	vise if no	o stored	hot wate	er (th <mark>is ir</mark>	ncludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in (47)			
Water	storage	loss:	o olovo d l	a a a fa atu										(12)
a) Ir m		urer's de	eciared I	OSS TACIO	or is kno	wn (kvvr	1/day):					0		(48)
Tempe	erature ta	actor fro	m Table					(40) (40)				0		(49)
b) If m	y lost iro nanufact	m water urer's de	eclared of	e, kvvn/ye cvlinder l	ear loss facto	or is not	known:	(48) X (49)	=		1	10		(50)
Hot wa	ater stora	age loss	factor fr	om Tabl	e 2 (kWl	h/litre/da	iy)				0.	02		(51)
If com	munity h	eating s	ee secti	on 4.3										
Volum	e factor	from Ta	ble 2a m Toblo	2h							1.	03		(52)
France								(47) (54)		50)	0	.6		(53)
Energy	(50) or (71 water 54) in (5	storage	e, KVVII/ye	al			(47) X (51)) X (52) X (oo) =	1.	03		(54) (55)
Water	storage	loss cal	culated t	for each	month			((56)m = (55) × (41)ı	m	ı.	05		(00)
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(56)
If cylinde	er contains	s dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (L H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(57)
Primar	y circuit	loss (ar	nual) fro	om Table	e 3			-				0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m		- (- ()			
(moo						olar wat	er neatil	ng and a			stat)	00.00		(50)
(59)m=	23.20	21.01	23.20		23.20	22.01	23.20	23.20	22.51	23.20	22.51	23.20		(59)
(61)m=	ioss cal		or each		0 m =	(00) ÷ 36	0 × (41	0	0	0	0	0		(61)
			1	1	I		I	1		I	I		l	

(22)m= 200.02 176.32 185.31 167.38 164.56 147.79 142.66 155.55 154.96 173.53 182.58 195.45 Solar DW input calculated using Appendix IC or Appendix II (negative quantity) (enter '0' if no solar contribution to water heating) (add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (60)m= 0	Total h	eat req	uired for	water h	eating ca	alculated	d fo	r each	n month	(62)	m =	0.85 × (45)m -	+ (46)m +	(57)m +	(59)m + (61)	m
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter 0' if no solar contribution to water heating (add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (c3)m= 0 <	(62)m=	200.02	176.52	185.91	167.38	164.56	14	47.79	142.66	155	.55	154.96	173.53	182.58	195.45		(62)
(add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (6)m= 0 <td>Solar DH</td> <td>-IW input</td> <td>calculated</td> <td>using App</td> <td>oendix G o</td> <td>r Appendix</td> <td>(Н (</td> <td>negativ</td> <td>e quantity</td> <td>) (ent</td> <td>er '0'</td> <td>if no solar</td> <td>r contrib</td> <td>ution to wate</td> <td>er heating)</td> <td>-</td> <td></td>	Solar DH	-IW input	calculated	using App	oendix G o	r Appendix	(Н (negativ	e quantity) (ent	er '0'	if no solar	r contrib	ution to wate	er heating)	-	
(e3)m= 0 </td <td>(add a</td> <td>dditiona</td> <td>al lines if</td> <td>FGHRS</td> <td>and/or</td> <td>WWHRS</td> <td>S ap</td> <td>plies,</td> <td>see Ap</td> <td>penc</td> <td>lix G</td> <td>B)</td> <td></td> <td></td> <td></td> <td>_</td> <td></td>	(add a	dditiona	al lines if	FGHRS	and/or	WWHRS	S ap	plies,	see Ap	penc	lix G	B)				_	
Output from water heater (64)me 200.02 176.52 185.91 167.38 164.56 147.79 142.66 155.55 154.90 173.53 182.58 195.45 Output from water heating, kWh/month 0.25 ' [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] 2046.91 (6) (6)me 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5 187.76 137.76 </td <td>(63)m=</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td></td> <td>0</td> <td>0</td> <td>0</td> <td>)</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td></td> <td>(63)</td>	(63)m=	0	0	0	0	0		0	0	0)	0	0	0	0		(63)
(64)m= 200.02 176.52 185.91 167.38 164.56 147.79 142.66 155.55 154.96 173.53 182.58 195.45 Output from water heating, kWh/month 0.25 '[0.85 x (45)m + (61)m] + 0.8 x [[46]m + (57)m + (59)m] 2046.91 (6)m= (65)m= 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6)m= (65)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Internal gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (60)m= 137.76	Output	from w	ater hea	ter													
Output from water heater (annual)9 2046.91 (6) Heat gains from water heating, kWh/month 0.25 ¹ [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] (6) (6) 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5 5 5 7 137.76	(64)m=	200.02	176.52	185.91	167.38	164.56	14	47.79	142.66	155	.55	154.96	173.53	182.58	195.45		
Heat gains from water heating, kWh/month 0.25 $^{\prime}$ [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] (85)m 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Internal gains (see Table 5 and 5a): Metabolic gains (Table 5), Watts <u>Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec</u> (86)m 137.76 13					-						Outp	out from wa	ater heat	er (annual)	12	2046.91	(64)
(65)m= 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6 include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Internal gains (see Table 5 and 5a): Metabolic gains (Table 5), Watts	Heat g	ains fro	m water	heating	, kWh/m	onth 0.2	5 ′	[0.85	× (45)m	+ (6	1)m	i] + 0.8 x	(46)r	n + (57)m	+ (59)m]	
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating S. Internal gains (see Table 5 and 5a): Metabolic gains (Table 5), Watts (a) Teb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (137.76 137.76	(65)m=	92.35	82.03	87.66	80.66	80.56	7	4.15	73.28	77.	56	76.53	83.54	85.72	90.83		(65)
S. Internal gains (see Table 5 and 5a): Metabolic gains (Table 5), Watts Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 137.76 <	inclu	ide (57)	m in calc	culation	of (65)m	only if c	ylir	nder is	s in the c	dwell	ing	or hot wa	ater is	from com	munity h	neating	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	5. Int	ernal g	ains (see	Table :	5 and 5a):											
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Metabo	olic gair	ns (Table	5). Wa	tts												
(66)me 137.76		Jan	Feb	Mar	Apr	May		Jun	Jul	Α	ug	Sep	Oct	Nov	Dec		
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (67)m 45.05 40.02 32.54 24.64 18.42 15.55 16.8 21.84 29.31 37.22 43.44 46.31 (6 Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68)m 301.71 304.84 296.95 280.16 258.96 239.03 225.72 222.59 230.48 247.27 268.47 288.4 (6 Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)m 51.07 51.07 51.07 51.07 51.07 51.07 51.07 51.07 51.07 51.07 51.07 51.07 51.07 (6 (70)m 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(66)m=	137.76	137.76	137.76	137.76	137.76	1:	37.76	137.76	137	.76	137.76	137.76	3 137.76	137.76		(66)
	Lightin	g gains	(calculat	ted in A	ppendix	L, equat	ion	L9 or	L9a), a	lso s	ee T	Fable 5					
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68) m = 301.71 304.84 296.95 280.16 258.96 239.03 225.72 222,59 230.48 247.27 268.47 288.4 (6 (69) m = 301.71 304.84 296.95 280.16 258.96 239.03 225.72 222,59 230.48 247.27 268.47 288.4 (6 Cooking gains (calculated in Appendix L, equation L15 or L16a), also see Table 5 (69) m = 61.07 52	(67)m=	45.05	40.02	32.54	24.64	18.42	1	5.55	16.8	21.	84	29.31	37.22	43.44	46.31		(67)
$\begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} $	Applia	nces ga	ains (calc	ulated i	n Appen	dix L, eq	uat	ion L1	13 or L1	3a), ;	also	see Tal	ble 5			1	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)m = 51.07 51	(68)m=	<u>30</u> 1.71	304.84	296.95	280.16	258.96	2:	39.03	225.72	222	.59	230.48	247.27	268.47	288.4		(68)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Cookin	ng gains	s (calcula	ted in A	ppendix	L. equat	tior	L15 (or L15a)	als	o se	e Table	5	_	<u> </u>	1	
Pumps and fans gains (Table 5a) (70)m 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(69)m=	5 <mark>1.07</mark>	51.07	51.07	51.07	51.07	5	1.07	51.07	51.	07	51.07	51.07	51.07	51.07		(69)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Pumps	and fa	ns gains	(Table	ц		-	I								1	
Losses e.g. evaporation (negative values) (Table 5) (71)m= $-91.84 - 91.84 -$	(70)m=	0	0	0	0	0		0	0	0		0	0	0	0		(70)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Losses	se.a. ev	vaporatio	n (nega	tive valu	es) (Tab	ble :	5)						<u> </u>			
Water heating gains (Table 5) (72)m= 124.12 122.07 117.82 112.03 108.28 102.99 98.49 104.25 106.3 112.29 119.05 122.08 (7 Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m= 567.88 563.93 544.31 513.82 482.64 454.56 438 445.67 463.08 493.77 527.95 553.78 (7 6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area m ² Flux g_ Flux g_ Fable 6b Table 6b Table 6c (W) North 0.9x 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7	(71)m=	-91.84	-91.84	-91.84	-91.84	-91.84	-9	91.84	-91.84	-91	.84	-91.84	-91.84	-91.84	-91.84]	(71)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Water	heating	ı gains (T	able 5)	1	Į	-	I						1	I	1	
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m= 567.88 563.93 544.31 513.82 482.64 454.56 438 445.67 463.08 493.77 527.95 553.78 (7 6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area m ² Flux g_ FF Gains Table 6a Table 6d m ² Table 6a Table 6b Table 6c (W) North $0.9x$ 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7	(72)m=	124.12	122.07	, 117.82	112.03	108.28	1(02.99	98.49	104	.25	106.3	112.29	119.05	122.08]	(72)
(73)m= 567.88 563.93 544.31 513.82 482.64 454.56 438 445.67 463.08 493.77 527.95 553.78 (7 6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux g_ FF Gains Orientation: Access Factor Area Flux g_ FF Gains North 0.9x 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7	Total i	nterna	l gains =					(66)	m + (67)m	+ (68	3)m +	- (69)m + (70)m +	(71)m + (72)	m	1	
6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux g_ FF Gains Table 6d m ² Table 6a Table 6b Table 6c (W) North 0.9x 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7)	(73)m=	567.88	563.93	544.31	513.82	482.64	4	54.56	438	445	.67	463.08	493.77	527.95	553.78]	(73)
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.Orientation:Access Factor Table 6dArea m²Flux Table 6ag_ Table 6aFF Table 6bGains (W)North $0.9x$ 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7)	6. Sol	lar gain	s:		•		•								I		
Orientation:Access Factor Table 6dArea m^2 Flux Table 6ag_ Table 6bFF Table 6bGains (W)North $0.9x$ 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7)	Solar g	ains are	calculated	using sola	ar flux from	Table 6a	and	associa	ated equa	tions	to co	nvert to th	e applic	able orientat	ion.		
North 0.9x 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7	Orienta	ation:	Access F Table 6d	actor	Area m²			Flux Tab	x ole 6a		Т	g_ able 6b		FF Table 6c		Gains (W)	
	North	0.9x	0.77	x	17	.6	x	1	0.63	x		0.5	x	0.8		51.88	(74)
North 0.9x 0.77 x 17.6 x 20.32 x 0.5 x 0.8 = 99.14 (7	North	0.9x	0.77	×	17	.6	x	2	0.32	x		0.5	×	0.8		99.14	(74)
North 0.9x 0.77 x 17.6 x 34.53 x 0.5 x 0.8 = 168.46 (7	North	0.9x	0.77	x	17	.6	x	3.	4.53	x		0.5	- ×	0.8		168.46	(74)
North 0.9x 0.77 x 17.6 x 55.46 x 0.5 x 0.8 = 270.6 (7	North	0.9x	0.77	x	17	.6	x	5	5.46	x		0.5	×	0.8	=	270.6	(74)
North 0.9x 0.77 x 17.6 x 74.72 x 0.5 x 0.8 = 364.52 (7	North	0.9x	0.77	×	17	.6	x	7	4.72	x		0.5	- ×	0.8	=	364.52	(74)
North 0.9x 0.77 x 17.6 x 79.99 x 0.5 x 0.8 = 390.23 (7	North	0.9x	0.77	×	17	.6	x	7	9.99	x		0.5	×	0.8	=	390.23	(74)
North 0.9x 0.77 x 17.6 x 74.68 x 0.5 x 0.8 = 364.33 (7	North	0.9x	0.77	×	17	.6	x	74	4.68	x		0.5	×	0.8	=	364.33	(74)
North 0.9x 0.77 x 17.6 x 59.25 x 0.5 x 0.8 = 289.05 (7	North	0.9x	0.77	×	17	.6	x	5	9.25	x		0.5	×	0.8	=	289.05	(74)

North	0.9x	0.77	x	17.6	x	41.52	x	0.5	×	0.8	=	202.55	(74)
North	0.9x	0.77	x	17.6	x	24.19] × [0.5		0.8	=	118.01	(74)
North	0.9x	0.77	×	17.6	x	13.12] × [0.5	_ × [0.8	=	64	(74)
North	0.9x	0.77	×	17.6	×	8.86	x 🗌	0.5	x	0.8	=	43.25	(74)
East	0.9x	0.77	x	7.9	x	19.64	x	0.5	×	0.8	=	43.01	(76)
East	0.9x	0.77	x	7.9	×	38.42	x	0.5	x	0.8	=	84.14	(76)
East	0.9x	0.77	x	7.9	x	63.27	x	0.5	x	0.8	=	138.56	(76)
East	0.9x	0.77	x	7.9	x	92.28	x	0.5	x	0.8	=	202.08	(76)
East	0.9x	0.77	×	7.9	x	113.09	x	0.5	x	0.8	=	247.66	(76)
East	0.9x	0.77	×	7.9	×	115.77	x	0.5	x	0.8	=	253.52	(76)
East	0.9x	0.77	x	7.9	x	110.22	x	0.5	×	0.8	=	241.36	(76)
East	0.9x	0.77	×	7.9	×	94.68	x	0.5	_ × [0.8	=	207.33	(76)
East	0.9x	0.77	×	7.9	×	73.59	x	0.5	_ × [0.8	=	161.15	(76)
East	0.9x	0.77	×	7.9	×	45.59	×	0.5	×	0.8	=	99.83	(76)
East	0.9x	0.77	×	7.9	x	24.49	x	0.5	×	0.8	=	53.63	(76)
East	0.9x	0.77	x	7.9	x	16.15	x	0.5	×	0.8	=	35.37	(76)
Solar (gains in	watts, calcu	lated	for each mon	th	40.75 005.00	(83)m = 3	Sum(74)m	. <mark>(8</mark> 2)m	447.00	70.00	7	(92)
(83)m=	94.89	ternal and	solar	(84)m = (73)n	³ ⁶	43.75 605.69	496.38	363.7	217.85	-117.63	78.62		(03)
(84)m=	662.77	747.2 85	1.33	986.5 1094.8	2 10	098.31 1043.69	942.04	826.78	711.62	645.58	632.4		(84)
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Z Ma	on inter	nal taranara		beeting								_	
7. Me	an inter	nal tempera	ature (heating seaso	n) ving	area from Ta		h1 (°C)					(85)
7. Me Temp	an inter perature	nal tempera during heat	ature (ting pe	heating seaso eriods in the li	on) ving m (s	area from Ta	ble 9, Tl	h1 (°C)				21	(85)
7. Me Temp Utilisa	ean inter perature ation fac	nal tempera during heat tor for gains Feb	ature (ting pe s for li Mar	heating seaso eriods in the li ving area, h1,	on) ving m (s	area from Ta ee Table 9a) Jun Jul	ble 9, Tl	h1 (°C)	Oct	Nov	Dec	21	(85)
7. Me Temp Utilisa (86)m=	ean inter perature ation fac Jan 0.87	nal tempera during heat tor for gains Feb I 0.81 0	ature (ting pe s for li Mar	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41	on) ving m (s	area from Ta ee Table 9a) Jun Jul 0.28 0.2	ble 9, Tl Aug 0.24	h1 (°C) Sep 0.4	Oct 0.64	Nov 0.81	Dec 0.88	21	(85)
7. Me Temp Utilisa (86)m=	ean inter perature ation fac Jan 0.87	nal tempera during heat tor for gains Feb I 0.81 0	nture (ting pe s for li Mar .72	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41	on) ving m (s y	area from Ta ee Table 9a) Jun Jul 0.28 0.2	ble 9, Tl Aug 0.24	h1 (°C) Sep 0.4	Oct 0.64	Nov 0.81	Dec 0.88	21	(85)
7. Me Temp Utilisa (86)m= Mear (87)m=	ean inter perature ation fac Jan 0.87 interna 20.24	hal temperation during heat tor for gains Feb I 0.81 0 I temperatu 20.43 20	ting pe s for li Mar .72 re in li 0.68	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97	on) ving m (s y (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21	ble 9, Tl Aug 0.24 7 in Tab	h1 (°C) Sep 0.4 lle 9c) 20.98	Oct 0.64 20.84	Nov 0.81	Dec 0.88 20.19		(85) (86) (87)
7. Me Temp Utilisa (86)m= Mear (87)m=	an inter perature ation fac Jan 0.87 0 interna 20.24	nal tempera during heat tor for gains Feb I 0.81 0 I temperatu 20.43 20	ature (ting pe s for li Mar 0.72 re in li 0.68	heating seaso priods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97	on) ving m (s v (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21	ble 9, Tl Aug 0.24 7 in Tab 21	h1 (°C) Sep 0.4 le 9c) 20.98	Oct 0.64 20.84	Nov 0.81 20.52	Dec 0.88 20.19	21	(85) (86) (87)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m=	ean inter perature ation fac Jan 0.87 interna 20.24 perature 20.35	nal tempera during heat tor for gains Feb I 0.81 0 temperature 20.43 20 during heat 20.35 20	ature (ting pe s for li Mar 0.72 re in li 0.68 ting pe	heating seaso eriods in the li ving area, h1, Apr May 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36	on) ving m (s y (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Ta 20.36 20.36	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, T	h1 (°C) Sep 0.4 le 9c) 20.98 Fh2 (°C) 20.36	Oct 0.64 20.84	Nov 0.81 20.52	Dec 0.88 20.19		(85) (86) (87) (88)
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7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (80)m=	an inter perature ation fac Jan 0.87 0.87 0.87 0.87 0.87 0.87 0.87 0.87	nal tempera during heat tor for gains Feb I 0.81 0 I temperatu 20.43 20 during heat 20.35 20 tor for gains	ting personal for the second s	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling	n) ving m (s / (follc (follc 2 (follc 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	area from Talee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 /elling from Ta 20.36 20.36 ,m (see Table	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, 1 20.36 9 a)	h1 (°C) Sep 0.4 le 9c) 20.98 Fh2 (°C) 20.36	Oct 0.64 20.84 20.36	Nov 0.81 20.52 20.36	Dec 0.88 20.19 20.35		(85) (86) (87) (88)
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7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m= Mear (90)m= Mear (92)m= Apply	an inter perature ation fac Jan 0.87 interna 20.24 perature 20.35 ation fac 0.85 interna 19.35	nal tempera during heat tor for gains Feb I 0.81 0 I temperatur 20.43 20 during heat 20.35 20 tor for gains 0.8 0 tor for gains 0 1 temperatur 19 19.61 15 I temperatur 19 19.94 20 nent to the r 20	ature (ting pe s for li Mar p.72 re in li p.68 ting pe p.35 s for re p.35 re in t 9.95 re (for p.24 mean	heating sease eriods in the li ving area, h1, Apr May 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwelling 20.22 20.32	on) ving m (s (follc (follc) (follc) (follc) (follc) (follc) (follc) (follc) (follc) (follc)) (follc) (fol	area from Tale ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Tale 20.36 20.36 0.25 0.18 172 (follow step 20.36 20.36 9) = fLA × T1 20.61 20.62 ure from Table 20.61 20.62	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, T 20.36 9a) 0.2 eps 3 to 20.36 + $(1 - f$ 20.62 e 4e, wh	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 7 in Table 20.34 ft LA) x T2 20.6 ere appro	Oct 0.64 20.84 20.36 0.61 20.17 20.17 A = Liv 20.44 priate	Nov 0.81 20.52 20.36 0.79 19.74 ing area ÷ (2 20.06	Dec 0.88 20.19 20.35 0.87 19.28 4) = 19.65		(85) (86) (87) (88) (89) (90) (91) (92)
7. Me Temp Utiliss (86)m= Mear (87)m= Temp (88)m= Utiliss (89)m= Mear (90)m= Mear (90)m= Mear (92)m= Apply (93)m=	an inter perature ation fac Jan 0.87 0.87 1 interna 20.24 20.35 ation fac 0.85 1 interna 19.35 1 interna 19.71 7 adjustn 19.71	nal tempera during heat tor for gains Feb I 0.81 0 I temperatur 20.43 20 during heat 20.43 20 during heat 20.35 20 tor for gains 0 1 temperatur 19.61 19.61 19 I temperatur 19.94 19.94 20 nent to the r 19.94 19.94 20	ature (ting pe s for li Mar 0.72 re in li 0.68 ting pe 0.35 s for re 0.35 s for re 0.35 re in t 9.95 re (for 0.24 mean 0.24	heating seaso priods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwelling 20.22 20.32	on) ving m (s ving (follc (follc 2 of dw 2 of dw 2 2 2 2 2 2 2 2 2 2 2 2 2	area from Tale ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Tale 20.36 20.36 0.25 0.18 1T2 (follow stee 20.36 20.36 g) = fLA × T1 20.61 20.62	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, 1 20.36 9 a) 0.2 9 a) 0.2 9 a) 0.2 9 a) 0.2 20.36 + (1 – f 20.62 + (20.62)	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 0.36 7 in Table 20.34 ft LA) × T2 20.6 ere appro 20.6	Oct 0.64 20.84 20.36 0.61 20.17 20.17 A = Liv 20.44 priate 20.44	Nov 0.81 20.52 20.36 0.79 19.74 ing area ÷ (4 20.06 20.06	Dec 0.88 20.19 20.35 0.87 19.28 19.28 19.65		(85) (86) (87) (88) (89) (90) (91) (91) (92) (93)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m= Mear (90)m= Mear (90)m= Mear (92)m= Apply (93)m= 8. Sp	an inter perature ation fac Jan 0.87 0.87 0.87 0.87 0.87 0.20.24 0erature 20.35 ation fac 0.85 0.85 0.85 0.85 0.85 0.85 0.85 0.85	nal tempera during heat tor for gains Feb I 0.81 0 I temperature 20 during heat 20 during heat 20 during heat 20 during heat 20 1 temperature 20 0.8 0 tor for gains 0 1 temperature 19 19.61 15 I temperature 20 19.94 20 nent to the r 19.94 19.94 20 ting require 19.94 nean intern 19.94	ature (ting pe s for li Mar 0.72 re in li 0.68 ting pe 0.35 s for re 0.35 s for re 0.35 re in ti 9.95 re (for 0.24 mean 0.24 mean 0.24	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwe 20.22 20.32 the whole dw 20.48 20.58 internal temp 20.48 20.58	y (follo))))))))))))))))))))))))))))))))))	area from Tale ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Tale 20.36 20.36	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, T 20.36 9a) 0.2 9a) 0.2 9a) 0.2 20.36 + (1 – f 20.62 + (20.62	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 7 in Table 20.34 ft LA) × T2 20.6 lere appro 20.6	Oct 0.64 20.84 20.36 0.61 20.17 20.17 A = Liv 20.44 priate 20.44	Nov 0.81 20.52 20.36 0.79 19.74 ing area ÷ (2 20.06 20.06	Dec 0.88 20.19 20.35 0.87 19.28 4) = 19.65 19.65	21 21 0.4	(85) (86) (87) (88) (89) (90) (91) (91) (92) (93)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m= Mear (90)m= Mear (90)m= Mear (92)m= Apply (93)m= 8. Sp Set T the u	an inter perature ation fac Jan 0.87 interna 20.24 perature 20.35 ation fac 0.85 interna 19.35 interna 19.71 y adjustn 19.71 ace hea i to the r tilisation	nal tempera during heat tor for gains Feb I 0.81 0 I temperatur 20.43 20 during heat 20.35 20 during heat 20.35 20 tor for gains 0 1 19.61 15 I temperatur 19.94 20 I temperatur 19.94 20 I temperatur 19.94 20 nent to the r 19.94 20 nent to the r 19.94 20 nean intern factor for g 0	ature (ting person s for li Mar 0.72 re in li 0.72 re in li 0.35 s for re 0.35 s for re 0.35 s for re 0.77 re in t 9.95 re (for 0.24 mean 0.24 ment al tem ains u	heating sease eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwelling 20.22 20.32 the whole dw 20.48 20.58 internal temp 20.48 20.58	innec	area from Tale ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Tale 20.36 20.36 0.25 0.18 172 (follow step 20.36 20.36 9) = fLA × T1 20.36 20.62 ure from Table 20.61 20.62 at step 11 of	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, T 20.36 9a) 0.2 9a) 0.2 9a) 0.2 9a) 0.2 eps 3 to 20.36 + (1 – f 20.62 e 4e, wh 20.62	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 7 in Table 20.34 ft LA) × T2 20.6 ere appro 20.6 Db, so that	Oct 0.64 20.84 20.36 0.61 20.17 20.17 A = Liv 20.44 priate 20.44	Nov 0.81 20.52 20.36 0.79 19.74 ing area ÷ (4 20.06 20.06 20.06	Dec 0.88 20.19 20.35 0.87 19.28 19.65 19.65 d re-cal	21 21 21 0.4	(85) (86) (87) (88) (89) (90) (91) (92) (93)

Litilion	tion for	tor for a	oino hr											
(94)m-	0.84	0.79		0.54	0.39	0.27	0.19	0.22	0.38	0.62	0.78	0.85		(94)
Usefu	l gains	hmGm	W = (9)	4)m x (84	4)m	0.27	0.10	0.22	0.00	0.02	0.10	0.00		(-)
(95)m=	556.34	587.58	588.84	535.55	427.2	291.1	195.22	204.38	311.68	439.25	505.48	540.24		(95)
Month	nly aver	age exte	ernal terr	perature	from Ta	able 8								
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat	loss rate	e for me	an interr	al tempe	erature,	Lm , W =	=[(39)m : I	x [(93)m	– (96)m]			I	(07)
(97)m=	765.67	746.33	680.62	569.25	435.82	292.62	195.52	204.9	317.2	482.91	637.76	762.66		(97)
Space (98)m=	155.74	g require 106.68	68.28	24.27	6.42		n = 0.02	24 X [(97])m – (95 0)m] x (4 32.49	1)m 95.24	165.48		
()						-		Tota	l per year	(kWh/year	r) = Sum(9	8)15.912 =	654.6	(98)
Space	- heatin	a requir	ement in	kWh/m^2	lvear						, , , , , , , , , , , , , , , , , , ,		9.08] [(99)
		grequit			booting	aabama							9.00	
90. En This na	ergy rec	uiremen ad for sr	11S - CO	nmunity ating spa	neating	ing or we	ator hoat	ting prov	ided by	a comm	unity sch	nomo		
Fractio	n of spa	ace heat	from se	condary/	supplen/	nentary l	neating ((Table 1	1) '0' if n	one	unity Sci	lenie.	0	(301)
Fractio	n of spa	ace heat	from co	mmunity	system	1 – (30 ⁻	1) =						1	(302)
The con	nmunity so	cheme ma	y obtain he	eat from se	everal sou	rces. The p	orocedure	allows for	CHP and i	up to four	other heat	sources; t	he latter	_
includes	boilers, h	eat pump	s, geother	mal and wa	aste heat f	rom powe	r stations.	See Appel	ndix C.					٦.
Fractio	n of hea	at from (Commun	ity boiler	S								1	(303a)
Fractio	n of tota	al space	heat fro	m Comn	nunity bo	oilers				(3	02) x (303	a) =	1	(304a)
Factor	for cont	rol and	charging	method	(Table	4c(3)) fo	r commu	unity hea	ting sys	tem			1	(305)
Distrib	ution los	s factor	(Table '	12c) for c	commun	ity heatii	ng syste	m					1.15	(306)
Spa <mark>ce</mark>	heating	9											k <mark>Wh/y</mark> ear	
Ann <mark>ua</mark>	l space	heating	requiren	nent									654.6	
Space	heat fro	om Comi	munity b	oilers					(98) x (30	04a) x (30	5) x (306)	=	752.79	(307a)
Efficier	ncy of s	econdar	y/supple	mentary	heating	system	in % (fro	om Table	e 4a or A	ppendix	E)		0	(308
Space	heating	require	ment fro	m secon	dary/su	oplemen	tary syst	tem	(98) x (30	01) x 100 -	÷ (308) =		0	(309)
Wator	heating													-
Annua	l water l	neating i	equirem	ent									2046.91	7
If DHW	/ from c	ommuni	ty schen	ne:										-
Water	heat fro	m Comr	nunity b	oilers					(64) x (30)3a) x (30	5) x (306) :	=	2353.95	(310a)
Electric	city use	d for hea	at distrib	ution				0.01	× [(307a).	(307e) +	· (310a)((310e)] =	31.07	(313)
Cooling	g Syste	m Energ	y Efficie	ncy Ratio	C								0	(314)
Space	cooling	(if there	is a fixe	ed cooling	g systen	n, if not e	enter 0)		= (107) ÷	(314) =			0	(315)
Electric mecha	city for p nical ve	oumps a ntilation	nd fans - baland	within dw ced, extra	velling (T act or po	Fable 4f) sitive in	: put from	outside					240.51	(330a)
warm a	air heati	ng syste	m fans										0	(330b)
pump f	or solar	water h	eating										0	_ (330g)
Total e	lectricity	/ for the	above I	kWh/vea	r				=(330a) -	+ (330b) +	(330a) =		240 51] (331)
		,			•				()	(,,,,,,,	(8) -		210.01	

Energy for lighting (calculated in Append	dix L)		318.27 (332)
10b. Fuel costs – Community heating s	scheme		
	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating from CHP	(307a) x	4.24 x 0	0.01 = 31.92 (340a
Water heating from CHP	(310a) x	4.24 × 0	0.01 = 99.81 (342a
		Fuel Price	
Pumps and fans	(331)	13.19 x 0	0.01 = 31.72 (349)
Energy for lighting	(332)	13.19 × (0.01 = 41.98 (350)
Additional standing charges (Table 12)			120 (351)
Total energy cost	= (340a)(342e) + (345)(354) =		325.43 (355)
11b. SAP rating - Community heating s	cheme		
Energy cost deflator (Table 12)			0.42 (356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =		1.17 (357)
SAP rating (section12)			83.72 (358)
12b. CO2 Emissions – Community heati CO2 from other sources of space and w	ater heating (not CHP)	rgy h/year Emission fa kg CO2/kW	actor Emissions /h kg CO2/year
CO2 associated with heat source 1	((307b)+(310b)] × 1	$00 \div (367b) x = 0.22$	= 740.79 (367)
Electrical energy for heat distribution	[(313) x	0.52	= 16.12 (372)
Total CO2 associated with community s	ystems (363)(36	6) + (368)(372)	= 765.91 (373)
CO2 associated with space heating (see	condary) (309) x	0	= 0 (374)
CO2 associated with water from immers	ion heater or instantaneous hea	ter (312) x 0.22	= 0 (375)
Total CO2 associated with space and w	ater heating (373) + (37	74) + (375) =	765.91 (376)
CO2 associated with electricity for pump	os and fans within dwelling (331)) x 0.52	= 124.82 (378)
CO2 associated with electricity for lightin	ng (332))) x	0.52	= 165.18 (379)
Total CO2, kg/year	sum of (376)(382) =		1055.91 (383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =		14.65 (384)
El rating (section 14)			87.92 (385)
13b. Primary Energy – Community heat	ing scheme		
	Ene kW	ergy Primary h/year factor	P.Energy kWh/year
Energy from other sources of space and Efficiency of heat source 1 (%)	I water heating (not CHP) If there is CHP using two fuels	repeat (363) to (366) for the seco	ond fuel 89.5 (367a
Energy associated with heat source 1	[(307b)+(310b)] x 1	00 ÷ (367b) x 1.22	= 4234.89 (367)
Electrical energy for heat distribution	[(313) x		= 95.38 (372)

Total Energy associated with community systems	(363)(366) + (368)(372)		=	4330.26	(373)
if it is negative set (373) to zero (unless specified otherwise	see C7 in Appendix C)			4330.26	(373)
Energy associated with space heating (secondary)	(309) x	0	=	0	(374)
Energy associated with water from immersion heater or instan	taneous heater(312) x	1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =			4330.26	(376)
Energy associated with space cooling	(315) x	3.07	=	0	(377)
Energy associated with electricity for pumps and fans within d	welling (331)) x	3.07	=	738.35	(378)
Energy associated with electricity for lighting	(332))) x	3.07	=	977.08	(379)
Total Primary Energy, kWh/year sum of (376)(382) =			6045.7	(383)



			User D	etails:						
Assessor Name: Software Name:	Stroma FSA	P 2012		Stroma Softwa	a Num are Ver	ber: sion:		Versio	n: 1.0.4.18	
			Property .	Address:	08_s_n	ו				
Address :	BIOCK JKL, Ag	jar Grove, Ca	maen, Lo	ondon, N	W191B					
Ground floor	1510115.		Area	a(m²) 72.1	(1a) x	Av. He	ight(m)	(2a) =	Volume(m ² 227.12	³)
Total floor area TFA = (1a	a)+(1b)+(1c)+(1c	d)+(1e)+(1	n)	72.1	(4)			-		
Dwelling volume			L		(3a)+(3b)	+(3c)+(3c	d)+(3e)+	.(3n) =	227.12	(5)
2. Ventilation rate:										
Number of chimneys Number of open flues	main heating 0	seconda heating + 0 + 0	ry + +	0 0] = [] = [total 0 0		40 = 20 =	0 0	ur (6a) (6b)
Number of intermittent far				-		0	x /	10 =	0	(7a)
Number of passive vents						0		10 -	0	
Number of passive vents					Ļ	0		10 -	0	(70)
Number of flueless gas fir	es		7-) - (7-) - (0		Air ch	0 anges per he	(7c)
Infiltration due to chimney	s, flues and fan	S = (ba) + (bb) + (bb	(7a)+(7b)+((C) =	continue fr	0	(16)	÷ (5) =	0	(8)
Number of storeys in th Additional infiltration Structural infiltration: 0.	e dwelling (ns) 25 for steel or ti	mber frame o	r 0.35 foi	r masonr	v constr	uction	[/0) [(9)·	-1]x0.1 =	0	(9) (10) (11)
if both types of wall are pro deducting areas of openin	esent, use the value gs); if equal user 0.	e corresponding 35	to the great	er wall are	a (after			ı ı		
If suspended wooden it	oor, enter 0.2 (t	tor 0).1 (seale	ea), eise	enter U				0	(12)
Percentage of windows	and doors drau	ucht stripped							0	(13)
Window infiltration		ight stripped		0.25 - [0.2	x (14) ÷ 1	00] =			0	(15)
Infiltration rate				(8) + (10)	+ (11) + (1	2) + (13) ·	+ (15) =		0	(16)
Air permeability value, o	q50, expressed	in cubic metr	es per ho	our per so	quare m	etre of e	envelope	area	1	(17)
If based on air permeabili	ty value, then (1	8) = [(17) ÷ 20]+	(8), otherwi	ise (18) = (16)				0.05	(18)
Air permeability value applies	s if a pressurisation	test has been do	ne or a deg	gree air pei	meability	is being u	sed			_
Number of sides sheltered	b			(20) – 1	0 075 v (1	0)1			2	(19)
Shelter factor	na chaltar facta	-		(20) = 1 - 1	0.075 X (1	9)] =			0.85	(20)
Infiltration rate modified for	ng sheller lacto	anaad		(21) = (10)	x (20) =				0.04	(21)
		May lup		Δυσ	Son	Oct	Nov	Dec		
Monthly over go wind on	ad from Table		Jui	Aug	Oep	001		Dec		
$(22)m = \begin{bmatrix} 5.1 \\ 5 \end{bmatrix} = \begin{bmatrix} 5.1 \\ 5 \end{bmatrix}$		4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
			1 0.0							
Wind Factor (22a)m = (22 (22a)m = 1.27 1 25 1	2)m ÷ 4	1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		
					•		L			

Adjust	ed infiltr	ation rate	e (allow	ing for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m				_	
_	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.05		
Calcul	ate effe	ctive air	change	rate for t	he appli	cable ca	se				•	-	- 	
IT ME	ecnanica			" N (0		、 - (. (201)				0.5	(23a)
If exh	aust air h	eat pump (using App	endix N, (2	(23a) = (23a	a) × Fmv (e	equation (f	N5)), othei	rwise (23b)) = (23a)			0.5	(23b)
lf bala	anced with	heat reco	overy: effic	iency in %	allowing f	or in-use f	actor (from	n Table 4h)) =				76.5	(23c)
a) If	balance	d mecha	anical ve	entilation	with hea	at recove	ery (MVI	HR) (24a	a)m = (22	2b)m + (23b) × [1 – (23c) ÷ 100]	
(24a)m=	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17		(24a)
b) If	balance	d mecha	anical ve	entilation	without	heat rec	covery (N	MV) (24b)m = (22	2b)m + (2	23b)			
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If	whole h	ouse ex	tract ver	ntilation of	or positiv	ve input v	ventilatio	on from c	outside		-	-	-	
i	if (22b)n	n < 0.5 ×	(23b), t	then (24d	c) = (23b); otherv	wise (24	c) = (22b	o) m + 0.	5 × (23b)			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If	natural	ventilatio	on or wh	ole hous	se positiv	/e input	ventilatio	on from l	oft		•	-	-	
i	if (22b)n	n = 1, the	en (24d)	m = (22	o)m othe	erwise (2	4d)m =	0.5 + [(2	2b)m² x	0.5]	-	_	_	
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effe	ctive air	change	rate - er	nter (24a) or (24t	o) or (24	c) or (24	d) in box	< (25)					
(25)m=	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17		(25)
0.110	of losses												-	
3. He	at losse	s and ne	eat loss		er:									
ELEN		area	8S (m²)	Openin	gs 2	Net Ar	ea n²	U-vait W/m2	ue :K	A X U (W/I	()	K-Value	e / K k	ч х к «J/K
Windo		e 1				17.6		[1/(0.85)+	⊦ 0.041 _ [14 47				(27)
Windo		2				7.0		۲ [1/(0 85)]	⊦ 0 04) – [6.40	H			(27)
Walla -		, 2				7.9		[1/(0.00)]		6.49	H,			(27)
vvaiis	гурет	41		17.6		23.4		0.2		4.68	Цļ			(29)
Walls	Гуре2	18.9	9	7.9		11	x	0.2	=	2.2				(29)
Total a	rea of e	lements	, m²			59.9								(31)
* for win	dows and	roof winde	ows, use e	effective wi	ndow U-va	alue calcul	ated using	formula 1	/[(1/U-valu	e)+0.04] a	ns given in	paragrapi	h 3.2	
** includ	le the area	as on both	sides of in	nternal wal	ls and part	titions								
Fabric	heat los	s, w/k =	= S (A x	U)				(26)(30)) + (32) =				27.84	(33)
Heat c	apacity	Cm = S(Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	584.8	(34)
Therm	al mass	parame	ter (TMI	⁻ = Cm ÷	- TFA) ir	n kJ/m²K			Indica	tive Value	: Low		100	(35)
For desi	gn assess	sments wh	ere the de	etails of the	construct	ion are not	t known pr	ecisely the	e indicative	values of	TMP in Ta	able 1f		
Thorm	al brida			uiaiion. culatod i		nondix l							0.00	
if dotails	of thorm	55.3 (L	A I) Cal		- 0.05 v (2		X						8.99	(30)
Total f	abric he	at loss	are not ki	101111 (30) =	= 0.00 X (3	1)			(33) +	(36) =			36.83	(37)
Ventila	tion her	at loss ca	alculater	1 monthly					(38)m	$-0.33 \times ($	25)m x (5)		50.05	
Ventile		Eob	Mor			lun		Δυα	Son				1	
(20)~~	Jan 10.07	10.70	10.71	Api 10.01	10.00	14.00	Jui 11.02	Aug	3ep		10.00	12.55	-	(38)
(00)11=	12.07	12.19	12.71	12.31	12.20	11.00	11.03	11.70	11.99	12.20	12.39	12.00	J	(00)
Heat tr	ansfer o	coefficier	nt, W/K						(39)m	= (37) + (3	38)m		-	
(39)m=	49.69	49.62	49.54	49.14	49.06	48.66	48.66	48.58	48.82	49.06	49.22	49.38		
		motor /	יאי ים וב	/m21/					(40)	Average =	Sum(39) ₁	12 /12=	49.12	(39)
	ss para		ז∟ <i>רי</i>), עע		0.00	0.07	0.07	0.07	(40)m	= (39)m ÷	(4)	0.00	1	
(40)m=	0.69	0.69	0.69	0.68	0.68	0.67	0.67	0.67	0.68	0.68	0.68	0.68	0.55	
									/	verage =	Sum(40)1	12 /12=	0.68	(40)

Numbe	er of day	rs in moi	nth (Tab	le 1a)			-	-		-	-			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Wa	ater heat	ing enei	rgy requ	irement:								kWh/ye	ear:	
Assum if TF if TF	ned occu A > 13.9 A £ 13.9	ipancy, l 9, N = 1 9, N = 1	N + 1.76 x	[1 - exp	(-0.0003	49 x (TF	⁻ A -13.9)2)] + 0.(0013 x (⁻	TFA -13.	2 9)	.3		(42)
Annua Reduce	l averag the annua	e hot wa al average litres per l	ater usag hot water	ge in litre usage by r day (all w	es per da 5% if the d	y Vd,av	erage = designed i Id)	(25 x N) to achieve	+ 36 a water us	se target o	88 f	.73		(43)
	.lan	Feb	Mar	Apr	May	Jun		Αυσ	Sen	Oct	Nov	Dec		
Hot wate	er usage in	n litres per	day for ea	ach month	Vd,m = factor	ctor from T	Table 1c x	(43)	Cop	000		200		
(44)m=	97.6	94.05	90.5	86.96	83.41	79.86	79.86	83.41	86.96	90.5	94.05	97.6		_
Energy	content of	hot water	used - cal	culated me	onthly $= 4$.	190 x Vd,n	n x nm x D)))))))))))))))))))) kWh/mor	Total = Su oth (see Ta	m(44) ₁₁₂ = ables 1b, 1	c, 1d)	1064.76	(44)
(45)m=	144.74	126.59	130.63	113.89	109.28	94.3	87.38	100.27	101.47	118.25	129.08	140.18		
				1					-	Total = Su	m(45) ₁₁₂ =		1396.07	(45)
lf instan	taneous w	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46) to (61)					
(46)m= Water	21.71 storage	18.99 loss:	19.59	17.08	16.39	14.14	13.11	15.04	15.22	17.74	19.36	21.03		(46)
Storag	e volum	e (litres)	includir	ng any so	olar or W	WHRS	storage	within sa	ame ves	sel		0		(47)
If com	munity h	eating a	ind no ta	ink in dw	velling, e	nter 110	litres in	(47)						
Otherv	vise if no	o stored	hot wate	er (th <mark>is ir</mark>	ncludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in (47)			
Water	storage	loss:	o olovo d l	a a a fa atu										(12)
a) Ir m		urer's de	eciared I	OSS TACIO	or is kno	wn (kvvr	1/day):					0		(48)
Tempe	erature ta	actor fro	m Table					(40) (40)				0		(49)
b) If m	y lost iro nanufact	m water urer's de	eclared of	e, kvvn/ye cvlinder l	ear loss facto	or is not	known:	(48) X (49)	=		1	10		(50)
Hot wa	ater stora	age loss	factor fr	om Tabl	e 2 (kWl	h/litre/da	iy)				0.	02		(51)
If com	munity h	eating s	ee secti	on 4.3										
Volum	e factor	from Ta	ble 2a m Toblo	2h							1.	03		(52)
France								(47) (54)		50)	0	.6		(53)
Energy	(50) or (71 water 54) in (5	storage	e, KVVII/ye	al			(47) X (51)) X (52) X (oo) =	1.	03		(54) (55)
Water	storage	loss cal	culated t	for each	month			((56)m = (55) × (41)ı	m	ı.	05		(00)
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(56)
If cylinde	er contains	s dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (L H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(57)
Primar	y circuit	loss (ar	nual) fro	om Table	e 3			-				0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m		- (- ()			
(moo						olar wat	er neatil	ng and a			stat)	00.00		(50)
(59)m=	23.20	21.01	23.20		23.20	22.01	23.20	23.20	22.51	23.20	22.51	23.20		(59)
(61)m=	ioss cal		or each		0 m =	(00) ÷ 36	0 × (41	0	0	0	0	0		(61)
			1	1	I		I	1		I	I		l	

(22)m= 200.02 176.32 185.31 167.38 164.56 147.79 142.66 155.55 154.96 173.53 182.58 195.45 Solar DW input calculated using Appendix IC or Appendix II (negative quantity) (enter '0' if no solar contribution to water heating) (add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (60)m= 0	Total h	eat req	uired for	water h	eating ca	alculated	d fo	r each	n month	(62)	m =	0.85 × (45)m -	+ (46)m +	(57)m +	(59)m + (61)	m
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter 0' if no solar contribution to water heating (add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (c3)m= 0 <	(62)m=	200.02	176.52	185.91	167.38	164.56	14	47.79	142.66	155	.55	154.96	173.53	182.58	195.45		(62)
(add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (6)m= 0 <td>Solar DH</td> <td>-IW input</td> <td>calculated</td> <td>using App</td> <td>oendix G o</td> <td>r Appendix</td> <td>(Н (</td> <td>negativ</td> <td>e quantity</td> <td>) (ent</td> <td>er '0'</td> <td>if no solar</td> <td>r contrib</td> <td>ution to wate</td> <td>er heating)</td> <td>-</td> <td></td>	Solar DH	-IW input	calculated	using App	oendix G o	r Appendix	(Н (negativ	e quantity) (ent	er '0'	if no solar	r contrib	ution to wate	er heating)	-	
(e3)m= 0 </td <td>(add a</td> <td>dditiona</td> <td>al lines if</td> <td>FGHRS</td> <td>and/or</td> <td>WWHRS</td> <td>S ap</td> <td>plies,</td> <td>see Ap</td> <td>penc</td> <td>lix G</td> <td>B)</td> <td></td> <td></td> <td></td> <td>_</td> <td></td>	(add a	dditiona	al lines if	FGHRS	and/or	WWHRS	S ap	plies,	see Ap	penc	lix G	B)				_	
Output from water heater (64)me 200.02 176.52 185.91 167.38 164.56 147.79 142.66 155.55 154.90 173.53 182.58 195.45 Output from water heating, kWh/month 0.25 ' [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] 2046.91 (6) (6)me 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5 187.76 137.76 </td <td>(63)m=</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td></td> <td>0</td> <td>0</td> <td>0</td> <td>)</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td></td> <td>(63)</td>	(63)m=	0	0	0	0	0		0	0	0)	0	0	0	0		(63)
(64)m= 200.02 176.52 185.91 167.38 164.56 147.79 142.66 155.55 154.96 173.53 182.58 195.45 Output from water heating, kWh/month 0.25 '[0.85 x (45)m + (61)m] + 0.8 x [[46]m + (57)m + (59)m] 2046.91 (6)m= (65)m= 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6)m= (65)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Internal gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (60)m= 137.76	Output	from w	ater hea	ter													
Output from water heater (annual)9 2046.91 (6) Heat gains from water heating, kWh/month 0.25 ¹ [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] (6) (6) 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5 5 5 7 137.76	(64)m=	200.02	176.52	185.91	167.38	164.56	14	47.79	142.66	155	.55	154.96	173.53	182.58	195.45		
Heat gains from water heating, kWh/month 0.25 $^{\prime}$ [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] (85)m 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Internal gains (see Table 5 and 5a): Metabolic gains (Table 5), Watts <u>Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec</u> (86)m 137.76 13					-						Outp	out from wa	ater heat	er (annual)	12	2046.91	(64)
(65)m= 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6 include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Internal gains (see Table 5 and 5a): Metabolic gains (Table 5), Watts	Heat g	ains fro	m water	heating	, kWh/m	onth 0.2	5 ′	[0.85	× (45)m	+ (6	1)m	i] + 0.8 x	: [(46)n	n + (57)m	+ (59)m]	
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating S. Internal gains (see Table 5 and 5a): Metabolic gains (Table 5), Watts (a) Teb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (137.76 137.76	(65)m=	92.35	82.03	87.66	80.66	80.56	7	4.15	73.28	77.	56	76.53	83.54	85.72	90.83		(65)
S. Internal gains (see Table 5 and 5a): Metabolic gains (Table 5), Watts Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 137.76 <	inclu	ide (57)	m in calc	culation	of (65)m	only if c	ylir	nder is	s in the c	dwell	ing	or hot w	ater is	from com	munity h	neating	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	5. Int	ernal g	ains (see	Table :	5 and 5a):											
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Metabo	olic gair	ns (Table	5). Wa	tts												
(66)me 137.76		Jan	Feb	Mar	Apr	May		Jun	Jul	Α	ug	Sep	Oct	Nov	Dec		
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (67)m 45.05 40.02 32.54 24.64 18.42 15.55 16.8 21.84 29.31 37.22 43.44 46.31 (6 Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68)m 301.71 304.84 296.95 280.16 258.96 239.03 225.72 222.59 230.48 247.27 268.47 288.4 (6 Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)m 51.07 51.07 51.07 51.07 51.07 51.07 51.07 51.07 51.07 51.07 51.07 51.07 51.07 (6 (70)m 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(66)m=	137.76	137.76	137.76	137.76	137.76	1:	37.76	137.76	137	.76	137.76	137.76	3 137.76	137.76		(66)
	Lightin	g gains	(calculat	ted in A	ppendix	L, equat	ion	L9 or	L9a), a	lso s	ee T	Fable 5					
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68) m = 301.71 304.84 296.95 280.16 258.96 239.03 225.72 222,59 230.48 247.27 268.47 288.4 (6 (69) m = 301.71 304.84 296.95 280.16 258.96 239.03 225.72 222,59 230.48 247.27 268.47 288.4 (6 Cooking gains (calculated in Appendix L, equation L15 or L16a), also see Table 5 (69) m = 61.07 52	(67)m=	45.05	40.02	32.54	24.64	18.42	1	5.55	16.8	21.	84	29.31	37.22	43.44	46.31		(67)
$\begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} $	Applia	nces ga	ains (calc	ulated i	n Appen	dix L, eq	uat	ion L1	13 or L1	3a), ;	also	see Tal	ble 5			1	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)m = 51.07 51	(68)m=	<u>30</u> 1.71	304.84	296.95	280.16	258.96	2:	39.03	225.72	222	.59	230.48	247.27	268.47	288.4		(68)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Cookin	ng gains	s (calcula	ted in A	ppendix	L. equat	tior	L15 (or L15a)	als	o se	e Table	5	_	<u> </u>	1	
Pumps and fans gains (Table 5a) (70)m 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(69)m=	5 <mark>1.07</mark>	51.07	51.07	51.07	51.07	5	1.07	51.07	51.	07	51.07	51.07	51.07	51.07		(69)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Pumps	and fa	ns gains	(Table	ц		-	I								1	
Losses e.g. evaporation (negative values) (Table 5) (71)m= $-91.84 - 91.84 -$	(70)m=	0	0	0	0	0		0	0	0		0	0	0	0		(70)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Losses	se.a. ev	vaporatio	n (nega	tive valu	es) (Tab	ble :	5)						-			
Water heating gains (Table 5) (72)m= 124.12 122.07 117.82 112.03 108.28 102.99 98.49 104.25 106.3 112.29 119.05 122.08 (7 Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m= 567.88 563.93 544.31 513.82 482.64 454.56 438 445.67 463.08 493.77 527.95 553.78 (7 6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area m ² Flux g_ Flux g_ Fable 6b Table 6b Table 6c (W) North 0.9x 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7	(71)m=	-91.84	-91.84	-91.84	-91.84	-91.84	-9	91.84	-91.84	-91	.84	-91.84	-91.84	-91.84	-91.84]	(71)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Water	heating	ı gains (T	able 5)	1	Į	-	I						1	I	1	
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m= 567.88 563.93 544.31 513.82 482.64 454.56 438 445.67 463.08 493.77 527.95 553.78 (7 6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area m ² Flux g_ FF Gains Table 6a Table 6d m ² Table 6a Table 6b Table 6c (W) North $0.9x$ 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7	(72)m=	124.12	122.07	117.82	112.03	108.28	1(02.99	98.49	104	.25	106.3	112.29	119.05	122.08]	(72)
(73)m= 567.88 563.93 544.31 513.82 482.64 454.56 438 445.67 463.08 493.77 527.95 553.78 (7 6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux g_ FF Gains Orientation: Access Factor Area Flux g_ FF Gains North 0.9x 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7	Total i	nterna	l gains =					(66)	m + (67)m	+ (68	3)m +	- (69)m + (70)m +	(71)m + (72)	m	1	
6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux g_ FF Gains Table 6d m ² Table 6a Table 6b Table 6c (W) North 0.9x 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7)	(73)m=	567.88	563.93	544.31	513.82	482.64	4	54.56	438	445	.67	463.08	493.77	527.95	553.78]	(73)
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.Orientation:Access Factor Table 6dArea m²Flux Table 6ag_ Table 6aFF Table 6bGains (W)North $0.9x$ 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7)	6. Sol	lar gain	s:		•		•							•	I		
Orientation:Access Factor Table 6dArea m²Flux Table 6ag_ Table 6aFF Table 6bGains (W)North $0.9x$ 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7)	Solar g	ains are	calculated	using sola	ar flux from	Table 6a	and	associa	ated equa	tions	to co	nvert to th	e applic	able orientat	ion.		
North 0.9x 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7	Orienta	ation:	Access F Table 6d	actor	Area m²			Flux Tab	x ole 6a		Т	g_ able 6b		FF Table 6c		Gains (W)	
	North	0.9x	0.77	x	17	.6	x	1	0.63	x		0.5	x	0.8		51.88	(74)
North 0.9x 0.77 x 17.6 x 20.32 x 0.5 x 0.8 = 99.14 (7	North	0.9x	0.77	×	17	.6	x	2	0.32	x		0.5	×	0.8		99.14	(74)
North 0.9x 0.77 x 17.6 x 34.53 x 0.5 x 0.8 = 168.46 (7	North	0.9x	0.77	x	17	.6	x	3.	4.53	x		0.5	- ×	0.8		168.46	(74)
North 0.9x 0.77 x 17.6 x 55.46 x 0.5 x 0.8 = 270.6 (7	North	0.9x	0.77	x	17	.6	x	5	5.46	x		0.5	×	0.8	=	270.6	(74)
North 0.9x 0.77 x 17.6 x 74.72 x 0.5 x 0.8 = 364.52 (7	North	0.9x	0.77	×	17	.6	x	7	4.72	x		0.5	- ×	0.8	=	364.52	(74)
North 0.9x 0.77 x 17.6 x 79.99 x 0.5 x 0.8 = 390.23 (7	North	0.9x	0.77	×	17	.6	x	7	9.99	x		0.5	×	0.8	=	390.23	(74)
North 0.9x 0.77 x 17.6 x 74.68 x 0.5 x 0.8 = 364.33 (7	North	0.9x	0.77	×	17	.6	x	74	4.68	x		0.5	×	0.8	=	364.33	(74)
North 0.9x 0.77 x 17.6 x 59.25 x 0.5 x 0.8 = 289.05 (7	North	0.9x	0.77	×	17	.6	x	5	9.25	x		0.5	×	0.8	=	289.05	(74)

North	0.9x	0.77	x	17.6	x	41.52	x	0.5	×	0.8	=	202.55	(74)
North	0.9x	0.77	x	17.6	x	24.19] × [0.5		0.8	=	118.01	(74)
North	0.9x	0.77	×	17.6	x	13.12] × [0.5	_ × [0.8	=	64	(74)
North	0.9x	0.77	×	17.6	×	8.86	x 🗌	0.5	x	0.8	=	43.25	(74)
East	0.9x	0.77	x	7.9	x	19.64	x	0.5	×	0.8	=	43.01	(76)
East	0.9x	0.77	x	7.9	×	38.42	x	0.5	x	0.8	=	84.14	(76)
East	0.9x	0.77	x	7.9	x	63.27	x	0.5	x	0.8	=	138.56	(76)
East	0.9x	0.77	x	7.9	x	92.28	x	0.5	x	0.8	=	202.08	(76)
East	0.9x	0.77	×	7.9	x	113.09	x	0.5	x	0.8	=	247.66	(76)
East	0.9x	0.77	×	7.9	×	115.77	x	0.5	x	0.8	=	253.52	(76)
East	0.9x	0.77	x	7.9	x	110.22	x	0.5	×	0.8	=	241.36	(76)
East	0.9x	0.77	×	7.9	×	94.68	x	0.5	_ × [0.8	=	207.33	(76)
East	0.9x	0.77	×	7.9	×	73.59	x	0.5	_ × [0.8	=	161.15	(76)
East	0.9x	0.77	×	7.9	×	45.59	×	0.5	×	0.8	=	99.83	(76)
East	0.9x	0.77	×	7.9	x	24.49	x	0.5	×	0.8	=	53.63	(76)
East	0.9x	0.77	x	7.9	x	16.15	x	0.5	×	0.8	=	35.37	(76)
Solar (gains in	watts, calcu	lated	for each mon	th	40.75 005.00	(83)m = 3	Sum(74)m	. <mark>(8</mark> 2)m	447.00	70.00	7	(92)
(83)m=	94.89	ternal and	solar	(84)m = (73)n	³ ⁶	43.75 605.69	496.38	363.7	217.85	-117.63	78.62		(03)
(84)m=	662.77	747.2 85	1.33	986.5 1094.8	2 10	098.31 1043.69	942.04	826.78	711.62	645.58	632.4		(84)
(~ ·/···													· · ·
Z Ma	on inter	nal taranara		beeting								_	
7. Me	an inter	nal tempera	ature (heating seaso	n) ving	area from Ta		h1 (°C)					(85)
7. Me Temp	an inter perature	nal tempera during heat	ature (ting pe	heating seaso eriods in the li	on) ving m (s	area from Ta	ble 9, Tl	h1 (°C)				21	(85)
7. Me Temp Utilisa	ean inter perature ation fac	nal tempera during heat tor for gains Feb	ature (ting pe s for li Mar	heating seaso eriods in the li ving area, h1,	on) ving m (s	area from Ta ee Table 9a) Jun Jul	ble 9, Tl	h1 (°C)	Oct	Nov	Dec	21	(85)
7. Me Temp Utilisa (86)m=	ean inter perature ation fac Jan 0.87	nal tempera during heat tor for gains Feb I 0.81 0	ature (ting pe s for li Mar	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41	on) ving m (s	area from Ta ee Table 9a) Jun Jul 0.28 0.2	ble 9, Tl Aug 0.24	h1 (°C) Sep 0.4	Oct 0.64	Nov 0.81	Dec 0.88	21	(85)
7. Me Temp Utilisa (86)m=	ean inter perature ation fac Jan 0.87	nal tempera during heat tor for gains Feb I 0.81 0	nture (ting pe s for li Mar .72	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41	on) ving m (s y	area from Ta ee Table 9a) Jun Jul 0.28 0.2	ble 9, Tl Aug 0.24	h1 (°C) Sep 0.4	Oct 0.64	Nov 0.81	Dec 0.88	21	(85)
7. Me Temp Utilisa (86)m= Mear (87)m=	ean inter perature ation fac Jan 0.87 interna 20.24	hal temperation during heat tor for gains Feb I 0.81 0 I temperatu 20.43 20	ting pe s for li Mar .72 re in li 0.68	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97	on) ving m (s y (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21	ble 9, Tl Aug 0.24 7 in Tab	h1 (°C) Sep 0.4 lle 9c) 20.98	Oct 0.64 20.84	Nov 0.81	Dec 0.88 20.19		(85) (86) (87)
7. Me Temp Utilisa (86)m= Mear (87)m=	an inter perature ation fac Jan 0.87 0 interna 20.24	nal tempera during heat tor for gains Feb I 0.81 0 I temperatu 20.43 20	ature (ting pe s for li Mar 0.72 re in li 0.68	heating seaso priods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97	on) ving m (s v (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21	ble 9, Tl Aug 0.24 7 in Tab 21	h1 (°C) Sep 0.4 le 9c) 20.98	Oct 0.64 20.84	Nov 0.81 20.52	Dec 0.88 20.19	21	(85) (86) (87)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m=	ean inter perature ation fac Jan 0.87 interna 20.24 perature 20.35	nal tempera during heat tor for gains Feb I 0.81 0 temperature 20.43 20 during heat 20.35 20	ting personal statements for library for library for library for the second statement of the second st	heating seaso eriods in the li ving area, h1, Apr May 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36	on) ving m (s y (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Ta 20.36 20.36	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, T	h1 (°C) Sep 0.4 le 9c) 20.98 Fh2 (°C) 20.36	Oct 0.64 20.84	Nov 0.81 20.52	Dec 0.88 20.19		(85) (86) (87) (88)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m=	ean inter perature ation fac Jan 0.87 interna 20.24 perature 20.35	nal temperaduring heattor for gainsFeb0.810.81120.4320.4320.3520.45	ting personal statements for library for l	heating sease eriods in the li ving area, h1, Apr May 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36	ving m (s (follc (follc	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Ta 20.36 20.36	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, 1 20.36	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36	Oct 0.64 20.84 20.36	Nov 0.81 20.52 20.36	Dec 0.88 20.19 20.35		(85) (86) (87) (88)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (80)m=	an inter perature ation fac Jan 0.87 0.87 0.87 0.87 0.87 0.87 0.87 0.87	nal tempera during heat tor for gains Feb I 0.81 0 I temperatu 20.43 20 during heat 20.35 20 tor for gains	ting personal for the second s	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling	n) ving m (s / (follc (follc 2 (follc 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	area from Talee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Ta 20.36 20.36 ,m (see Table	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, 1 20.36 9 a)	h1 (°C) Sep 0.4 le 9c) 20.98 Fh2 (°C) 20.36	Oct 0.64 20.84 20.36	Nov 0.81 20.52 20.36	Dec 0.88 20.19 20.35		(85) (86) (87) (88)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m=	an inter perature ation fac Jan 0.87 interna 20.24 perature 20.35 ation fac 0.85	nal temperaduring heattor for gainsFebI0.8101 temperatur20.4320during heat20.3520tor for gains0.80.80	ature (ting pe s for li Mar 0.72 re in li 0.68 ting pe 0.35 s for re 0.7	heating sease eriods in the li ving area, h1, Apr May 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38	(follc (follc)))) , h2	area from Talee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Ta 20.36 20.36 ,m (see Table 0.25 0.18	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, T 20.36 9 a) 0.2	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36	Oct 0.64 20.84 20.36 0.61	Nov 0.81 20.52 20.36 0.79	Dec 0.88 20.19 20.35 0.87		(85) (86) (87) (88) (89)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m= Mear	an inter perature ation fac Jan 0.87 interna 20.24 perature 20.35 ation fac 0.85	nal tempera during heat tor for gains Feb I 0.81 0 I temperatur 20.43 20 during heat 20.35 20 tor for gains 0.8 0.8	ature (ting pe s for li Mar 0.72 re in li 0.68 ting pe 0.35 s for re 0.35 re in t	heating sease eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwe	y (follc (follc))))))))))))))))))	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Ta 20.36 20.36 ,m (see Table 0.25 0.18 T2 (follow step	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, 1 20.36 9 a) 0.2 eps 3 to	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 0.36 7 in Table	Oct 0.64 20.84 20.36 0.61 0.61	Nov 0.81 20.52 20.36 0.79	Dec 0.88 20.19 20.35 0.87		(85) (86) (87) (88) (89)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m= Mear (90)m=	an inter perature ation fac Jan 0.87 interna 20.24 perature 20.35 ation fac 0.85 interna 19.35	nal temperaduring heattor for gainsFeb0.810temperatur20.4320.4320.3520.3520.351tor for gains0.80.80.8119.6115	ature (ting pe s for li Mar 0.72 re in li 0.68 ting pe 0.35 s for re 0.7 re in t 9.95	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwe 20.22 20.32	on) ving m (s y (follc 2 2 2 2 3 4 5 f dw 1 2 2 2 3 1 2 2 2 3 1 2 2 2 2 2 3 2 2 2 2	area from Tale ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Tale 20.36 20.36 ,m (see Table 0.25 0.18 T2 (follow stee 20.36 20.36	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, 1 20.36 9a) 0.2 eps 3 to 20.36	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 0.36 7 in Table 20.34	Oct 0.64 20.84 20.36 0.61 20.17	Nov 0.81 20.52 20.36 0.79 19.74	Dec 0.88 20.19 20.35 0.87 19.28		(85) (86) (87) (88) (89) (90)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m= Mear (90)m=	an inter perature ation fac Jan 0.87 interna 20.24 perature 20.35 ation fac 0.85 interna 19.35	nal tempera during heat tor for gains Feb I 0.81 0 1 temperatur 20.43 20 during heat 20.35 20 tor for gains 0 1 temperatur 20.35 20 tor for gains 0 1 temperatur 0 19.61 15	ature (ting pe s for li Mar 0.72 re in li 0.68 ting pe 0.35 s for re 0.7 re in t 9.95	heating sease eriods in the li ving area, h1, Apr May 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwelling 20.22 20.32	on) ving (follc (follc (follc) (follc) (follc) (follc) (follc) (follc) (follc) (area from Tale ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Tale 20.36 20.36 ,m (see Table 0.25 0.18 T2 (follow stee 20.36 20.36	ble 9, Tl Aug 0.24 7 in Tab 21 20.36 9a) 0.2 eps 3 to 20.36	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 7 in Table 20.34 ft	Oct 0.64 20.84 20.36 0.61 e 9c) 20.17 _A = Liv	Nov 0.81 20.52 20.36 0.79 19.74 ing area ÷ (4	Dec 0.88 20.19 20.35 0.87 19.28 4) =		(85) (86) (87) (88) (89) (90) (91)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m= Mear (90)m=	an inter perature ation fac Jan 0.87 0.87 1 interna 20.24 20.35 ation fac 0.85 1 interna 19.35	nal tempera during heat tor for gains Feb I 0.81 0 I temperatur 20.43 20 during heat 20.35 20 tor for gains 0 1 temperatur 0 0.8 0 I temperatur 0 19.61 19 I temperatur 19 1 temperatur 19	ting personal statements for line personal statements for line personal statements for respective statements for respectiv	heating seaso priods in the living area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 priods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwe 20.22 20.32	on) ving m (s v (follc (follc (follc (follc) velling velling	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Ta 20.36 20.36 ,m (see Table 0.25 0.18 T2 (follow stee 20.36 20.36 g) = fLA × T1	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, 1 20.36 9 a) 0.2 eps 3 to 20.36 + (1 – f	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 7 in Table 20.34 ft LA) × T2	Oct 0.64 20.84 20.36 0.61 e 9c) 20.17 .A = Liv	Nov 0.81 20.52 20.36 0.79 19.74 ing area ÷ (4	Dec 0.88 20.19 20.35 0.87 19.28 4) =		(85) (86) (87) (88) (89) (90) (91)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m= Mear (90)m= Mear (90)m=	an inter perature ation fac Jan 0.87 0.87 1 interna 20.24 20.35 ation fac 0.85 1 interna 19.35	nal tempera during heat tor for gains Feb I 0.81 0 temperature 20.43 20.43 20 during heat 20.35 ctor for gains 0 tor for gains 0 1 19.61 19.94 20	ature (ting pe s for li Mar 0.72 re in li 0.68 ting pe 0.35 s for re 0.7 re in t 9.95 re (for 0.24	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwe 20.22 20.32	ying m (s y (follo y	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Ta 20.36 20.36 0.25 0.18 T2 (follow state 20.36 20.36 g) = fLA × T1 20.61 20.62	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, T 20.36 9a) 0.2 eps 3 to 20.36 + (1 – f 20.62	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 7 in Table 20.34 ft LA) × T2 20.6	Oct 0.64 20.84 20.36 0.61 \Rightarrow 9c) 20.17 A = Liv 20.44	Nov 0.81 20.52 20.36 0.79 19.74 ing area ÷ (4 20.06	Dec 0.88 20.19 20.35 0.87 19.28 19.28 19.65		(85) (86) (87) (88) (89) (90) (91) (92)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m= Mear (90)m= Mear (92)m= Apply	an inter perature ation fac Jan 0.87 interna 20.24 perature 20.35 ation fac 0.85 interna 19.35	nal tempera during heat tor for gains Feb I 0.81 0 I temperatur 20.43 20 during heat 20.35 20 tor for gains 0.8 0 tor for gains 0 1 temperatur 19 19.61 15 I temperatur 19 19.94 20 nent to the r 20	ature (ting pe s for li Mar p.72 re in li p.68 ting pe p.35 s for re p.35 re in t 9.95 re (for p.24 mean	heating sease eriods in the li ving area, h1, Apr May 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwelling 20.22 20.32	on) ving m (s (follc (follc) (follc) (follc) (follc) (follc) (follc) (follc) (follc) (follc)) (follc) (fol	area from Tale ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Tale 20.36 20.36 0.25 0.18 172 (follow step 20.36 20.36 9) = fLA × T1 20.61 20.62 ure from Table 20.61 20.62	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, T 20.36 9a) 0.2 eps 3 to 20.36 + $(1 - f$ 20.62 e 4e, wh	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 7 in Table 20.34 ft LA) x T2 20.6 ere appro	Oct 0.64 20.84 20.36 0.61 20.17 20.17 A = Liv 20.44 priate	Nov 0.81 20.52 20.36 0.79 19.74 ing area ÷ (2 20.06	Dec 0.88 20.19 20.35 0.87 19.28 4) = 19.65		(85) (86) (87) (88) (89) (90) (91) (92)
7. Me Temp Utiliss (86)m= Mear (87)m= Temp (88)m= Utiliss (89)m= Mear (90)m= Mear (90)m= Mear (92)m= Apply (93)m=	an inter perature ation fac Jan 0.87 0.87 1 interna 20.24 20.35 ation fac 0.85 1 interna 19.35 1 interna 19.71 7 adjustn 19.71	nal tempera during heat tor for gains Feb I 0.81 0 I temperatur 20.43 20 during heat 20.43 20 during heat 20.35 20 tor for gains 0 1 temperatur 19.61 19.61 19 I temperatur 19.94 19.94 20 nent to the r 19.94 19.94 20	ature (ting pe s for li Mar 0.72 re in li 0.68 ting pe 0.35 s for re 0.35 s for re 0.35 re in t 9.95 re (for 0.24 mean 0.24	heating seaso priods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwelling 20.22 20.32	on) ving m (s ving (follc (follc 2 of dw 2 of dw 2 2 of dw 2 2 2 2 2 2 2 2 2 2 2 2 2	area from Tale ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Tale 20.36 20.36 0.25 0.18 1T2 (follow stee 20.36 20.36 g) = fLA × T1 20.61 20.62	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, 1 20.36 9 a) 0.2 9 a) 0.2 9 a) 0.2 9 a) 0.2 20.36 + (1 – f 20.62 + (20.62)	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 0.36 7 in Table 20.34 ft LA) × T2 20.6 ere appro 20.6	Oct 0.64 20.84 20.36 0.61 20.17 20.17 A = Liv 20.44 priate 20.44	Nov 0.81 20.52 20.36 0.79 19.74 ing area ÷ (4 20.06 20.06	Dec 0.88 20.19 20.35 0.87 19.28 19.28 19.65		(85) (86) (87) (88) (89) (90) (91) (91) (92) (93)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m= Mear (90)m= Mear (90)m= Mear (92)m= Apply (93)m= 8. Sp	an inter perature ation fac Jan 0.87 0.87 0.87 0.87 0.87 0.20.24 0erature 20.35 ation fac 0.85 0.85 0.85 0.85 0.85 0.85 0.85 0.85	nal tempera during heat tor for gains Feb I 0.81 0 I temperature 20.43 20.43 20 during heat 20.35 20.35 20 tor for gains 0 0.8 0 temperature 19.61 19.61 19 19.94 20 nent to the r 19.94 19.94 20 nent to the r 19.94 19.94 20	ature (ting pe s for li Mar 0.72 re in li 0.68 ting pe 0.35 s for re 0.35 s for re 0.35 re in ti 9.95 re (for 0.24 mean 0.24 mean 0.24	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwe 20.22 20.32 the whole dw 20.48 20.58 internal temp 20.48 20.58	y (follo))))))))))))))))))))))))))))))))))	area from Tale ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Tale 20.36 20.36	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, T 20.36 9a) 0.2 9a) 0.2 9a) 0.2 20.36 + (1 – f 20.62 + (20.62	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 7 in Table 20.34 ft LA) × T2 20.6 lere appro 20.6	Oct 0.64 20.84 20.36 0.61 20.17 20.17 A = Liv 20.44 priate 20.44	Nov 0.81 20.52 20.36 0.79 19.74 ing area ÷ (2 20.06 20.06	Dec 0.88 20.19 20.35 0.87 19.28 4) = 19.65 19.65	21 21 0.4	(85) (86) (87) (88) (89) (90) (91) (91) (92) (93)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m= Mear (90)m= Mear (90)m= Mear (92)m= Apply (93)m= 8. Sp Set T the u	an inter perature ation fac Jan 0.87 0.87 0 interna 20.24 0 erature 20.35 ation fac 0.85 0 interna 19.35 0 interna 19.71 7 adjustn 19.71 ace hea i to the r tilisation	nal tempera during heat tor for gains Feb I 0.81 0 I temperatur 20.43 20 during heat 20.35 20 during heat 20.35 20 tor for gains 0 1 19.61 15 I temperatur 19.94 20 I temperatur 19.94 20 I temperatur 19.94 20 nent to the r 19.94 20 nent to the r 19.94 20 nean intern factor for g 0	ature (ting person s for li Mar 0.72 re in li 0.72 re in li 0.35 s for re 0.35 s for re 0.35 s for re 0.77 re in t 9.95 re (for 0.24 mean 0.24 ment al tem ains u	heating sease eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwelling 20.22 20.32 the whole dw 20.48 20.58 internal temp 20.48 20.58 internal temp 20.48 20.58	innec	area from Tale ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Tale 20.36 20.36 0.25 0.18 172 (follow step 20.36 20.36 9) = fLA × T1 20.36 20.62 ure from Table 20.61 20.62 at step 11 of	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, T 20.36 9a) 0.2 eps 3 to 20.36 + $(1 - f)$ 20.62 e 4e, wh 20.62 Table 9	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 7 in Table 20.34 ft LA) × T2 20.6 ere appro 20.6 Db, so that	Oct 0.64 20.84 20.36 0.61 20.17 20.17 A = Liv 20.44 priate 20.44	Nov 0.81 20.52 20.36 0.79 19.74 ing area ÷ (4 20.06 20.06 20.06	Dec 0.88 20.19 20.35 0.87 19.28 19.65 19.65 d re-cal	21 21 21 0.4	(85) (86) (87) (88) (89) (90) (91) (92) (93)

Utilisatio	n factor for g	ains, hm	n:										
(94)m= 0	.84 0.79	0.69	0.54	0.39	0.27	0.19	0.22	0.38	0.62	0.78	0.85		(94)
Useful g	ains, hmGm	, W = (94	4)m x (84	4)m									
(95)m= 55	6.34 587.58	588.84	535.55	427.2	291.1	195.22	204.38	311.68	439.25	505.48	540.24		(95)
Monthly	average exte	ernal tem	perature	e from Ta	able 8							l	(00)
(96)m=	4.3 4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
(97)m = 76	5 67 746 33	an intern	569 25	435 82	Lm , vv =	=[(39)m]	x [(93)m 204 9	- (96)m 317.2	482.91	637 76	762 66		(97)
Space he	eating requir	ement fo	or each m	nonth. k	Nh/mont	h = 0.02	24 x [(97)m – (95)ml x (4	1)m	102.00		(-)
(98)m= 15	5.74 106.68	68.28	24.27	6.42	0	0	0	0	32.49	95.24	165.48		
		1					Tota	l per year	(kWh/year	·) = Sum(9	8)15,912 =	654.6	(98)
Space h	eating requir	ement in	kWh/m²	/year								9.08	(99)
9b. Energ	y requireme	nts – Coi	mmunity	heating	scheme)							-4
This part i	s used for s	bace hea	ating, spa	ace cool	ing or wa	ater heat	ting prov	ided by	a comm	unity scł	neme.		_
Fraction c	f space heat	from se	condary/	/supplen	nentary l	heating ((Table 1	1) '0' if n	one			0	(301)
Fraction c	f space heat	from co	mmunity	system	1 – (301	1) =						1	(302)
The commu	nity scheme ma	y obtain he	eat from se	everal sou	rces. The p	orocedure	allows for	CHP and l	up to four	other heat	sources; t	he latter	
includes boi	lers, heat pump f heat from (s, geotheri	mal and wa ity boiler	aste heat f S	rom powei	r stations.	See Appel	ndix C.		_		1](<u>303a</u>)
Fraction	f total apage	boot fro			ailoro				(2	02) v (202	a) -	4	$\int_{(2040)}^{(2040)}$
		neat no		(Table					(5	02) X (303	a) =	1	
Factor for	control and	charging		(Table -	4C(3)) 10	r commu	unity nea	ating sys	tem			1	
Distributio	in loss factor	(Table	IZC) for C	commun	ity neatir	ng syste	m					1.07	(306)
Space he Annual sp	ating ace heating	requiren	nent									654.6	1
Space he	at from Com	munity b	oilers					(98) x (30	04a) x (30	5) x (306) :	=	700.42	(307a)
Efficiency	of secondar	y/supple	mentary	heating	system	in % (fro	om Table	e 4a or A	ppendix	E)		0	(308
Space he	ating require	ment fro	m secon	dary/su	oplemen	tary syst	tem	(98) x (30	01) x 100 -	÷ (308) =		0	(309)
Water he	ating												
Annual wa	ater heating	requirem	ient									2046.91	
If DHW fro Water hea	om communi at from Comi	ty schen nunity bo	ne: oilers					(64) x (30	03a) x (30	5) x (306) :	=	2190.2	(310a)
Electricity	used for hea	at distrib	ution				0.01	× [(307a).	(307e) +	· (310a)((310e)] =	28.91	(313)
Cooling S	ystem Energ	y Efficie	ncy Ratio	C								0	(314)
Space co	oling (if there	e is a fixe	ed cooling	g systen	n, if not e	enter 0)		= (107) ÷	· (314) =			0	(315)
Electricity mechanic	for pumps a al ventilation	nd fans - balanc	within dw ced, extra	velling (T act or po	Fable 4f) sitive inj	: put from	outside					240.51	(330a)
warm air I	neating syste	em fans			-							0	(330b)
pump for	solar water h	eating										0	(330g)
Total elec	tricity for the	above, l	kWh/yea	r				=(330a) -	+ (330b) +	(330g) =		240.51	(331)
			-									i.	_

Energy for lighting (calculated in Apper	ndix L)			318.27	(332)
10b. Fuel costs – Community heating	scheme				
	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a) x	4.24	0.01 =	29.7	(340a)
Water heating from CHP	(310a) x	4.24	0.01 =	92.86	(342a)
		Fuel Price			
Pumps and fans	(331)	13.19	(0.01 =	31.72	(349)
Energy for lighting	(332)	13.19	(0.01 =	41.98	(350)
Additional standing charges (Table 12)				120	(351)
Total energy cost	= (340a)(342e) + (345)(354) =			316.26	(355)
11b. SAP rating - Community heating	scheme				
Energy cost deflator (Table 12)			Г	0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =			1.13	(357)
SAP rating (section12)				84.18	(358)
12b. CO2 Emissions - Community hea	ting scheme				
	Ene	rgy Emission	factor E	miss <mark>ions</mark>	
		ky COZ/K		g COzryeai	
Efficiency of heat source 1 (%)	If there is CHP using two fuels	repeat (363) to (366) for the se	econd fuel	92	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 1	00 ÷ (367b) x 0.22	=	678.67	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	15	(372)
Total CO2 associated with community	systems (363)(36	66) + (368)(372)	=	693.67	(373)
CO2 associated with space heating (se	condary) (309) x	0	=	0	(374)
CO2 associated with water from immer	sion heater or instantaneous hea	ter (312) x 0.22	=	0	(375)
Total CO2 associated with space and v	vater heating (373) + (37	74) + (375) =		693.67	(376)
CO2 associated with electricity for pum	ps and fans within dwelling (331))) x 0.52	=	124.82	(378)
CO2 associated with electricity for light	ing (332))) x	0.52	=	165.18	(379)
Total CO2, kg/year	sum of (376)(382) =			983.67	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			13.64	(384)
El rating (section 14)				88.74	(385)
13b. Primary Energy – Community hea	ting scheme	.		_	
	Ene kWl	ergy Primary h/year factor	P. k\	.⊏nergy Wh/year	
Energy from other sources of space an Efficiency of heat source 1 (%)	d water heating (not CHP) If there is CHP using two fuels	repeat (363) to (366) for the se	econd fuel	92	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 1	00 ÷ (367b) x 1.22	=	3833.21	(367)
Electrical energy for heat distribution	[(313) x			88.74	(372)
	- /	L			_ ` `

Total Energy associated with community systems	(363)(366) + (368)(372)		=	3921.95	(373)
if it is negative set (373) to zero (unless specified otherwise,	see C7 in Appendix C)			3921.95	(373)
Energy associated with space heating (secondary)	(309) x	0	=	0	(374)
Energy associated with water from immersion heater or instan	taneous heater(312) x	1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =			3921.95	(376)
Energy associated with space cooling	(315) x	3.07	=	0	(377)
Energy associated with electricity for pumps and fans within de	welling (331)) x	3.07	=	738.35	(378)
Energy associated with electricity for lighting	(332))) x	3.07	=	977.08	(379)
Total Primary Energy, kWh/year sum of (376)	(382) =			5637.39	(383)



			User D	etails:						
Assessor Name: Software Name:	Stroma FSA	P 2012		Stroma Softwa	a Num are Ver	ber: sion:		Versio	n: 1.0.4.18	
			Property .	Address:	08_s_n	ו				
Address :	BIOCK JKL, Ag	jar Grove, Ca	maen, Lo	ondon, N	W191B					
Ground floor	1510115.		Area	a(m²) 72.1	(1a) x	Av. He	ight(m)	(2a) =	Volume(m ² 227.12	³)
Total floor area TFA = (1a	a)+(1b)+(1c)+(1c	d)+(1e)+(1	n)	72.1	(4)			-		
Dwelling volume			L		(3a)+(3b)	+(3c)+(3c	d)+(3e)+	.(3n) =	227.12	(5)
2. Ventilation rate:										
Number of chimneys Number of open flues	main heating 0	seconda heating + 0 + 0	ry + +	0 0] = [] = [total 0 0		40 = 20 =	0 0	ur (6a) (6b)
Number of intermittent far				-		0	x /	10 =	0	(7a)
Number of passive vents						0		10 -	0	
Number of passive vents					Ļ	0		10 -	0	(70)
Number of flueless gas fir	es		7-) - (7-) - (0		Air ch	0 anges per he	(7c)
Infiltration due to chimney	s, flues and fan	S = (ba) + (bb) + (bb	(7a)+(7b)+((C) =	continue fr	0	(16)	÷ (5) =	0	(8)
Number of storeys in th Additional infiltration Structural infiltration: 0.	e dwelling (ns) 25 for steel or ti	mber frame o	r 0.35 foi	r masonr	v constr	uction	[/0) [(9)·	-1]x0.1 =	0	(9) (10) (11)
if both types of wall are pro deducting areas of openin	esent, use the value gs); if equal user 0.	e corresponding 35	to the great	er wall are	a (after			ı ı		
If suspended wooden it	oor, enter 0.2 (t	tor 0).1 (seale	ea), eise	enter U				0	(12)
Percentage of windows	and doors drau	ucht stripped							0	(13)
Window infiltration		ight stripped		0.25 - [0.2	x (14) ÷ 1	00] =			0	(15)
Infiltration rate				(8) + (10)	+ (11) + (1	2) + (13) ·	+ (15) =		0	(16)
Air permeability value, o	q50, expressed	in cubic metr	es per ho	our per so	quare m	etre of e	envelope	area	1	(17)
If based on air permeabili	ty value, then (1	8) = [(17) ÷ 20]+	(8), otherwi	ise (18) = (16)				0.05	(18)
Air permeability value applies	s if a pressurisation	test has been do	ne or a deg	gree air pei	meability	is being u	sed			_
Number of sides sheltered	b			(20) – 1	0 075 v (1	0)1			2	(19)
Shelter factor	na chaltar facta	-		(20) = 1 - 1	0.075 X (1	9)] =			0.85	(20)
Infiltration rate modified for	ng sheller lacto	anaad		(21) = (10)	x (20) =				0.04	(21)
		May lup		Δυσ	Son	Oct	Nov	Dec		
Monthly over go wind on	ad from Table		Jui	Aug	Oep	001		Dec		
$(22)m = \begin{bmatrix} 5.1 \\ 5 \end{bmatrix} = \begin{bmatrix} 5.1 \\ 5 \end{bmatrix}$		4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
			1 0.0							
Wind Factor (22a)m = (22 (22a)m = 1.27 1 25 1	2)m ÷ 4	1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		
					•		L			

Adjust	ed infiltr	ation rate	e (allow	ing for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m				_	
_	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.05		
Calcul	ate effe	ctive air	change	rate for t	he appli	cable ca	se				•	-	- 	
IT ME	ecnanica			" N (0		、 - (. (201)				0.5	(23a)
If exh	aust air h	eat pump (using App	endix N, (2	(23a) = (23a	a) × Fmv (e	equation (f	N5)), othei	rwise (23b)) = (23a)			0.5	(23b)
lf bala	anced with	heat reco	overy: effic	iency in %	allowing f	or in-use f	actor (from	n Table 4h)) =				76.5	(23c)
a) If	balance	d mecha	anical ve	entilation	with hea	at recove	ery (MVI	HR) (24a	a)m = (22	2b)m + (23b) × [1 – (23c) ÷ 100]	
(24a)m=	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17		(24a)
b) If	balance	d mecha	anical ve	entilation	without	heat rec	covery (N	MV) (24b)m = (22	2b)m + (2	23b)			
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If	whole h	ouse ex	tract ver	ntilation of	or positiv	ve input v	ventilatio	on from c	outside		-		-	
i	if (22b)n	n < 0.5 ×	(23b), t	then (24d	c) = (23b); otherv	wise (24	c) = (22b	o) m + 0.	5 × (23b)			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If	natural	ventilatio	on or wh	ole hous	se positiv	/e input	ventilatio	on from l	oft		•	-	-	
i	if (22b)n	n = 1, the	en (24d)	m = (22	o)m othe	erwise (2	4d)m =	0.5 + [(2	2b)m² x	0.5]	-	_	_	
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effe	ctive air	change	rate - er	nter (24a) or (24t	o) or (24	c) or (24	d) in box	< (25)					
(25)m=	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17		(25)
0.110	of losses												-	
3. He	at losse	s and ne	eat loss	paramete	er:									
ELEN		area	8S (m²)	Openin	gs 2	Net Ar	ea n²	U-vait W/m2	ue :K	A X U (W/I	()	K-Value	e / K k	ч х к «J/K
Windo		e 1				17.6		[1/(0.85)+	⊦ 0.041 _ [14 47				(27)
Windo		2				7.0		۲ [1/(0 85)]	⊦ 0 04) – [6.40	H			(27)
Welle -		, 2				7.9		[1/(0.00)]		6.49	H,			(27)
vvaiis	гурет	41		17.6		23.4		0.2		4.68	Цļ			(29)
Walls	Гуре2	18.9	9	7.9		11	x	0.2	=	2.2				(29)
Total a	rea of e	lements	, m²			59.9								(31)
* for win	dows and	roof winde	ows, use e	effective wi	ndow U-va	alue calcul	ated using	formula 1	/[(1/U-valu	e)+0.04] a	ns given in	paragrapi	h 3.2	
** includ	le the area	as on both	sides of in	nternal wal	ls and part	titions								
Fabric	heat los	s, w/k =	= S (A x	U)				(26)(30)) + (32) =				27.84	(33)
Heat c	apacity	Cm = S(Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	584.8	(34)
Therm	al mass	parame	ter (TMI	⁻ = Cm ÷	- TFA) ir	n kJ/m²K			Indica	tive Value	: Low		100	(35)
For desi	gn assess	sments wh	ere the de	etails of the	construct	ion are not	t known pr	ecisely the	e indicative	values of	TMP in Ta	able 1f		
Thorm	al briday			uiaiion. culatod i		nondix l							0.00	
if dotails	of thorm	55.3 (L	A I) Cal		- 0.05 v (2		X						8.99	(30)
Total f	abric he	at loss	are not ki	101111 (30) =	= 0.00 X (3	1)			(33) +	(36) =			36.83	(37)
Ventila	tion her	at loss ca	alculater	1 monthly					(38)m	$-0.33 \times ($	25)m x (5)		50.05	
Ventile		Eob	Mor			lun		Δυα	Son				1	
(20)~~	Jan 10.07	10.70	10.71	Api 10.01	10.00	14.02	Jui 11.02	Aug	3ep		10.00	12.55	-	(38)
(00)11=	12.07	12.19	12.71	12.31	12.20	11.00	11.03	11.70	11.99	12.20	12.39	12.00	J	(00)
Heat tr	ansfer o	coefficier	nt, W/K						(39)m	= (37) + (3	38)m		-	
(39)m=	49.69	49.62	49.54	49.14	49.06	48.66	48.66	48.58	48.82	49.06	49.22	49.38		
		motor /	יאי ים וב	/m21/					(40)	Average =	Sum(39) ₁	12 /12=	49.12	(39)
	ss para		ז∟ <i>רי</i>), עע		0.00	0.07	0.07	0.07	(40)m	= (39)m ÷	(4)	0.00	1	
(40)m=	0.69	0.69	0.69	0.68	0.68	0.67	0.67	0.67	0.68	0.68	0.68	0.68	0.55	
									/	verage =	Sum(40)1	12 /12=	0.68	(40)

Numbe	er of day	rs in moi	nth (Tab	le 1a)				-		-				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Wa	ater heat	ing enei	rgy requ	irement:								kWh/ye	ear:	
Assum if TF if TF	ned occu A > 13.9 A £ 13.9	ıpancy, l ∂, N = 1 ∂, N = 1	N + 1.76 x	[1 - exp	(-0.0003	849 x (TF	FA -13.9)2)] + 0.(0013 x (⁻	TFA -13.	2 9)	.3		(42)
Annua Reduce	l averag the annua	e hot wa al average litres per l	ater usag hot water	ge in litre usage by r day (all w	es per da 5% if the d	ay Vd,av	erage = designed i Id)	(25 x N) to achieve	+ 36 a water us	se target o	88 f	.73		(43)
	.lan	Feb	Mar	Apr	May	Jun	.lul	Αυσ	Sen	Oct	Nov	Dec		
Hot wate	er usage in	n litres per	day for ea	ach month	Vd,m = factor	ctor from T	Table 1c x	(43)	Cop	000		200		
(44)m=	97.6	94.05	90.5	86.96	83.41	79.86	79.86	83.41	86.96	90.5	94.05	97.6		_
Energy	content of	hot water	used - cal	culated me	onthly $= 4$.	190 x Vd,n	n x nm x D)))))))))))))))))))) kWh/mor	Total = Su hth (see Ta	m(44) ₁₁₂ = ables 1b, 1	c, 1d)	1064.76	(44)
(45)m=	144.74	126.59	130.63	113.89	109.28	94.3	87.38	100.27	101.47	118.25	129.08	140.18		
				1					-	Total = Su	m(45) ₁₁₂ =		1396.07	(45)
lf instan	taneous w	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46) to (61)					
(46)m= Water	21.71 storage	18.99 loss:	19.59	17.08	16.39	14.14	13.11	15.04	15.22	17.74	19.36	21.03		(46)
Storag	e volum	e (litres)	includir	ng any so	olar or W	WHRS	storage	within sa	ame ves	sel		0		(47)
If com	munity h	eating a	ind no ta	ink in dw	velling, e	nter 110	litres in	(47)						
Otherv	vise if no	o stored	hot wate	er (th <mark>is ir</mark>	ncludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in (47)			
Water	storage	loss:	o olovo d l	a a a fa atu										(12)
a) Ir m		urer's de	eciared I	OSS TACIO	or is kno	wn (kvvr	Vday):					0		(48)
Tempe	erature ta	actor fro	m Table					(40) (40)				0		(49)
b) If m	y lost iro nanufact	m water urer's de	eclared of	e, kvvn/ye cvlinder l	ear loss facto	or is not	known:	(48) X (49)	=		1	10		(50)
Hot wa	ater stora	age loss	factor fr	om Tabl	e 2 (kWl	h/litre/da	ıy)				0.	02		(51)
If com	munity h	eating s	ee secti	on 4.3										
Volum	e factor	from Ta	ble 2a m Toblo	2h							1.	03		(52)
France								(47) (54)		50)	0	.6		(53)
Energy	(50) or (71 water 54) in (5	storage	e, KVVII/ye	al			(47) X (51)) X (52) X (53) =	1.	03		(54) (55)
Water	storage	loss cal	culated t	for each	month			((56)m = (55) × (41)ı	m	ı.	05		(00)
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(56)
If cylinde	er contains	s dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(57)
Primar	y circuit	loss (ar	nual) fro	om Table	e 3			-				0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = (58) ÷ 36	65 × (41)	m		- (- ()			
(moo	Diffed by	Tactor fi		10 H5 lf t		solar wat	er neatil	ng and a			stat)	22.20		(50)
(59)M=	23.20	21.01	23.20	22.51	23.20	22.01 (CO) - C(23.20	23.20	22.51	23.20	22.51	23.20		(39)
(61)m=	ioss cal		or each		0 m =	$(00) \div 30$	0 × (41	0	0	0	0	0		(61)
			1	1	I			1		1	I		I	

(82)m= 200.02 176.32 185.31 167.38 164.56 147.79 142.66 155.55 154.96 173.53 182.58 195.45 Solar DHW input calculated using Appendix G or Appendix I (negative quantity) (enter 1° if no solar contribution to water heating) (add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (6) Golm= 0	Total h	eat req	uired for	water h	eating c	alculated	d fo	r each	n month	(62)	m =	0.85 × (45)m -	+ (46)m +	(57)m +	(59)m + (61)	m	
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating) (add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (6)	(62)m=	200.02	176.52	185.91	167.38	164.56	14	47.79	142.66	155	.55	154.96	173.53	3 182.58	195.45		(62)	
(add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (6)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Solar DH	-IW input	calculated	using App	pendix G o	r Appendix	к Н (negativ	e quantity) (ent	er '0'	if no solar	r contrib	ution to wate	er heating)	-		
(e3)m= 0 </td <td>(add a</td> <td>dditiona</td> <td>al lines if</td> <td>FGHRS</td> <td>and/or</td> <td>WWHRS</td> <td>S ap</td> <td>plies,</td> <td>see Ap</td> <td>penc</td> <td>lix G</td> <td>B)</td> <td></td> <td></td> <td></td> <td>_</td> <td></td>	(add a	dditiona	al lines if	FGHRS	and/or	WWHRS	S ap	plies,	see Ap	penc	lix G	B)				_		
Output from water heater (64)me 200.02 176.52 185.91 167.38 164.56 147.79 142.66 155.55 154.96 173.53 182.58 195.45 Output from water heating, kWh/month 0.25 ' [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] (6) (6)me 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 33.74 87.76 137.76	(63)m=	0	0	0	0	0		0	0	0)	0	0	0	0		(63)	
(64)m= 200.02 176.52 185.91 167.38 164.56 147.79 142.66 155.55 154.96 173.53 182.58 195.45 Output from water heating, kWh/month 0.25 '[0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] (6)m= 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6)m= (60)m= 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6)m= (65)m calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (6) <td co<="" td=""><td>Output</td><td>from w</td><td>ater hea</td><td>ter</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td>	<td>Output</td> <td>from w</td> <td>ater hea</td> <td>ter</td> <td></td>	Output	from w	ater hea	ter													
Output from water heater (annual)	(64)m=	200.02	176.52	185.91	167.38	164.56	14	47.79	142.66	155	.55	154.96	173.53	3 182.58	195.45			
Heat gains from water heating, kWh/month 0.25 ⁷ [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m] (85)m 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6 include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Internal gains (see Table 5 and 5a): Metabolic gains (Table 5), Watts (66)m 137.76 13					-	-					Outp	out from wa	ater heat	ter (annual)	12	2046.91	(64)	
(65)m= 92.35 82.03 87.66 80.66 80.56 74.15 73.28 77.56 76.53 83.54 85.72 90.83 (6) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating 5. Internal gains (see Table 5 and 5a): Metabolic gains (Table 5), Watts	Heat g	ains fro	m water	heating	, kWh/m	onth 0.2	5 ′	[0.85	× (45)m	+ (6	1)m	i] + 0.8 x	(46)r	n + (57)m	+ (59)m]		
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating S. Internal gains (see Table 5 and 5a): Metabolic gains (Table 5), Watts (66)m= Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (6) (137.76 137.76	(65)m=	92.35	82.03	87.66	80.66	80.56	7	4.15	73.28	77.	56	76.53	83.54	85.72	90.83		(65)	
S. Internal gains (see Table 5 and 5a): Metabolic gains (Table 5), Watts Jan Feb Mar Apr May Jun	inclu	ide (57)	m in calo	culation	of (65)m	only if c	ylir	nder is	s in the c	dwell	ing	or hot w	ater is	from com	munity h	neating		
Metabolic gains (Table 5), Watts Metabolic gains (Table 5), Watts Mar Apr May Jun Jul Aug Sep Oct Nov Dec (66)m= 137.76	5. Int	ernal g	ains (see	a Table :	5 and 5a	ı):												
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (66)me 137.76<	Metabo	olic gair	ns (Table	. 5). Wa	tts													
(66)me 137.76		Jan	Feb	Mar	Apr	May		Jun	Jul	Α	ug	Sep	Oct	Nov	Dec			
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (67)m= $45.05 + 40.02 + 32.54 + 24.64 + 18.42 + 15.55 + 16.8 + 21.84 + 29.31 + 37.22 + 43.44 + 46.91$	(66)m=	137.76	137.76	137.76	137.76	137.76	1:	37.76	137.76	137	.76	137.76	137.76	6 137.76	137.76		(66)	
	Lightin	g gains	(calcula	ted in A	ppendix	L, equat	ion	L9 or	[.] L9a), a	lso s	ee T	Fable 5						
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68)m= 301.71 304.84 296.95 280.16 258.96 239.03 225.72 222.59 230.48 247.27 268.47 288.4 (68)m= 301.71 304.84 296.95 280.16 258.96 239.03 225.72 222.59 230.48 247.27 268.47 288.4 Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)m= 51.07	(67)m=	45.05	40.02	32.54	24.64	18.42	1	5.55	16.8	21.	84	29.31	37.22	43.44	46.31		(67)	
$\begin{array}{c} (68) m = & 301.71 & 304.84 & 296.95 & 280.16 & 258.96 & 239.03 & 225.72 & 222.59 & 230.48 & 247.27 & 268.47 & 288.4 \\ \hline (68) m = & 301.71 & 304.84 & 296.95 & 280.16 & 258.96 & 239.03 & 225.72 & 222.59 & 230.48 & 247.27 & 268.47 & 288.4 \\ \hline (cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 \\ \hline (69) m = & 51.07 & 51.07 & 51.07 & 51.07 & 51.07 & 51.07 & 51.07 & 51.07 & 51.07 \\ \hline (70) m = & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 &$	Applia	nces ga	ains (calc	ulated i	n Appen	dix L, eq	uat	ion L1	13 or L1	3a), ;	also	see Tal	ble 5			1		
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)m = 51.07 527.95 553.78 (7) 7 73 50.3 544.31 513.82 482.64 454.56 438 445.67 463.08 493.77 527.95 553.78 (7) 6 Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux	(68)m=	<u>30</u> 1.71	304.84	296.95	280.16	258.96	2	39.03	225.72	222	.59	230.48	247.27	268.47	288.4		(68)	
$\begin{array}{c} (69)m = & 51.07 & 51.07 & 51.07 & 51.07 & 51.07 & 51.07 & 51.07 & 51.07 & 51.07 & 51.07 & 51.07 & 51.07 & 51.07 \\ \text{Pumps and fans gains (Table 5a)} \\ (70)m = & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 &$	Cookin	ng gains	s (calcula	ted in A	ı ppendix	L. equa	tior	L15	or L15a)	als	o se	e Table	5	-	<u> </u>	1		
Pumps and fans gains (Table 5a) (70)m 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(69)m=	5 <mark>1.07</mark>	51.07	51.07	51.07	51.07	5	1.07	51.07	51.	07	51.07	51.07	51.07	51.07		(69)	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Pumps	and fa	ns gains	(Table	1 5a)			I								1		
Losses e.g. evaporation (negative values) (Table 5) (71)m= -91.84 $-91.$	(70)m=	0	0	0	0	0	Γ	0	0	0		0	0	0	0		(70)	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Losses	se.a. ev	vaporatio	n (neas	tive valu	ies) (Tab	ble	5)										
Water heating gains (Table 5) (72)m= 124.12 122.07 117.82 112.03 108.28 102.99 98.49 104.25 106.3 112.29 119.05 122.08 (7 Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m= 567.88 563.93 544.31 513.82 482.64 454.56 438 445.67 463.08 493.77 527.95 553.78 (7 6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux g_ FF Gains Table 6d m ² Table 6a Table 6b Table 6c (W) North 0.9x 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7	(71)m=	-91.84	-91.84	-91.84	-91.84	-91.84	-9	, 91.84	-91.84	-91	.84	-91.84	-91.84	-91.84	-91.84]	(71)	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Water	heating	gains (T	able 5)	ł	I	1	I						-!		1		
Total internal gains = $(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$ (73)m= 567.88 563.93 544.31 513.82 482.64 454.56 438 445.67 463.08 493.77 527.95 553.78 (7 6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux g_ FF Gains Table 6d m ² Table 6a Table 6b Table 6c (W) North 0.9x 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7	(72)m=	124.12	122.07	117.82	112.03	108.28	1(02.99	98.49	104	.25	106.3	112.29	119.05	122.08		(72)	
(73)m=567.88563.93544.31513.82482.64454.56438445.67463.08493.77527.95553.78(76. Solar gains:Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.Orientation:Access FactorAreaFlux g_{-} FFGainsTable 6dm²Table 6aTable 6aTable 6bTable 6c(W)North $0.9x$ 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7	Total i	nterna	l gains =			•		(66)	m + (67)m	+ (68	3)m +	- (69)m + (70)m +	(71)m + (72)	m			
6. Solar gains: Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux g_ FF Gains Table 6d m ² Table 6a Table 6b Table 6c (W) North 0.9x 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7)	(73)m=	567.88	563.93	544.31	513.82	482.64	4	54.56	438	445	.67	463.08	493.77	7 527.95	553.78		(73)	
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Table 6a Area Flux g_ FF Gains Table 6b North 0.9x 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7)	6. Sol	lar gain	s:													•		
Orientation:Access FactorAreaFluxg_FFGainsTable 6dm²Table 6aTable 6bTable 6c(W)North $0.9x$ 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7)	Solar g	ains are	calculated	using sola	ar flux from	n Table 6a	and	associ	ated equa	tions	to co	nvert to th	e applic	able orientat	ion.			
North 0.9x 0.77 x 17.6 x 10.63 x 0.5 x 0.8 = 51.88 (7	Orienta	ation:	Access F Table 6d	actor	Area m²	l		Flu: Tab	x ble 6a		Т	g_ able 6b		FF Table 6c		Gains (W)		
	North	0.9x	0.77	x	17	<i>.</i> .6	x	1	0.63	x		0.5	x	0.8	=	51.88	(74)	
North 0.9x 0.77 x 17.6 x 20.32 x 0.5 x 0.8 = 99.14 (7	North	0.9x	0.77	×	17	<i>'</i> .6	x	2	0.32	x		0.5	×	0.8	=	99.14	(74)	
North 0.9x 0.77 x 17.6 x 34.53 x 0.5 x 0.8 = 168.46 (7	North	0.9x	0.77	×	17	' .6	x	3	4.53	x		0.5	- x	0.8	=	168.46	(74)	
North 0.9x 0.77 x 17.6 x 55.46 x 0.5 x 0.8 = 270.6 (7	North	0.9x	0.77	×	17	′.6	x	5	5.46	x		0.5	×	0.8	=	270.6	(74)	
North 0.9x 0.77 x 17.6 x 74.72 x 0.5 x 0.8 = 364.52 (7	North	0.9x	0.77	×	17	′.6	x	7	4.72	x		0.5	×	0.8	=	364.52	(74)	
North 0.9x 0.77 x 17.6 x 79.99 x 0.5 x 0.8 = 390.23 (7	North	0.9x	0.77	×	17	'.6	x	7	9.99	x		0.5	×	0.8	=	390.23	(74)	
North 0.9x 0.77 x 17.6 x 74.68 x 0.5 x 0.8 = 364.33 (7	North	0.9x	0.77	×	17		x	7	4.68	x		0.5	×	0.8	=	364.33	(74)	
North 0.9x 0.77 x 17.6 x 59.25 x 0.5 x 0.8 = 289.05 (7	North	0.9x	0.77	×	17	′ .6	x	5	9.25	x		0.5	×	0.8	=	289.05	(74)	

North	0.9x	0.77	x	17.6	x	41.52	x	0.5	×	0.8	=	202.55	(74)
North	0.9x	0.77	x	17.6	x	24.19		0.5	_ × [0.8	=	118.01	(74)
North	0.9x	0.77	×	17.6	x	13.12] × [0.5	_ × [0.8	=	64	(74)
North	0.9x	0.77	×	17.6	×	8.86	x 🗌	0.5	x	0.8	=	43.25	(74)
East	0.9x	0.77	x	7.9	x	19.64	x	0.5	×	0.8	=	43.01	(76)
East	0.9x	0.77	x	7.9	×	38.42	x	0.5	x	0.8	=	84.14	(76)
East	0.9x	0.77	x	7.9	x	63.27	x	0.5	x	0.8	=	138.56	(76)
East	0.9x	0.77	x	7.9	x	92.28	x	0.5	x	0.8	=	202.08	(76)
East	0.9x	0.77	×	7.9	x	113.09	x	0.5	x	0.8	=	247.66	(76)
East	0.9x	0.77	×	7.9	×	115.77	x	0.5	x	0.8	=	253.52	(76)
East	0.9x	0.77	x	7.9	x	110.22	x	0.5	×	0.8	=	241.36	(76)
East	0.9x	0.77	×	7.9	x	94.68	x	0.5	_ × [0.8	=	207.33	(76)
East	0.9x	0.77	×	7.9	×	73.59	x	0.5	_ × [0.8	=	161.15	(76)
East	0.9x	0.77	×	7.9	×	45.59	×	0.5	×	0.8	=	99.83	(76)
East	0.9x	0.77	×	7.9	x	24.49	x	0.5	×	0.8	=	53.63	(76)
East	0.9x	0.77	x	7.9	x	16.15	x	0.5	×	0.8	=	35.37	(76)
Solar (gains in	watts, calcu	lated	for each mon	th	40.75 005.00	(83)m = 3	Sum(74)m	. <mark>(8</mark> 2)m	447.00	70.00	7	(92)
(83)m=	94.89	ternal and	solar	(84)m = (73)n	³ ⁶	43.75 605.69	496.38	363.7	217.85	-117.63	78.62		(03)
(84)m=	662.77	747.2 85	1.33	986.5 1094.8	2 10	098.31 1043.69	942.04	826.78	711.62	645.58	632.4		(84)
(~ .)													· · ·
Z Ma	on inter	nal taranara		beeting									
7. Me	an inter	nal tempera	ature (heating seaso	on) ving	area from Ta		h1 (°C)					(85)
7. Me Temp	an inter perature	nal tempera during heat	ature (ting pe	heating seaso eriods in the li	on) ving	area from Ta	ble 9, Tl	h1 (°C)				21	(85)
7. Me Temp Utilisa	ean inter perature ation fac	nal tempera during heat tor for gains Feb	ature (ting pe s for li Mar	heating seaso eriods in the li ving area, h1,	on) ving m (s	area from Ta ee Table 9a) Jun Jul	ble 9, Tl	h1 (°C)	Oct	Nov	Dec	21	(85)
7. Me Temp Utilisa (86)m=	ean inter perature ation fac Jan 0.87	nal tempera during heat tor for gains Feb I 0.81 0	ature (ting pe s for li Mar	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41	on) ving m (s	area from Ta ee Table 9a) Jun Jul 0.28 0.2	ble 9, Tl Aug 0.24	h1 (°C) Sep 0.4	Oct 0.64	Nov 0.81	Dec 0.88	21	(85)
7. Me Temp Utilisa (86)m=	ean inter perature ation fac Jan 0.87	nal tempera during heat tor for gains Feb I 0.81 0	nture (ting pe s for li Mar .72	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41	on) ving m (s y	area from Ta ee Table 9a) Jun Jul 0.28 0.2	ble 9, Tl Aug 0.24	h1 (°C) Sep 0.4	Oct 0.64	Nov 0.81	Dec 0.88	21	(85)
7. Me Temp Utilisa (86)m= Mear (87)m=	ean inter perature ation fac Jan 0.87 interna 20.24	hal temperation during heat tor for gains Feb I 0.81 0 I temperatu 20.43 20	ting pe s for li Mar .72 re in li 0.68	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97	on) ving m (s y (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21	ble 9, Tl Aug 0.24 7 in Tab	h1 (°C) Sep 0.4 lle 9c) 20.98	Oct 0.64 20.84	Nov 0.81	Dec 0.88 20.19		(85) (86) (87)
7. Me Temp Utilisa (86)m= Mear (87)m=	an inter perature ation fac Jan 0.87 0 interna 20.24	nal tempera during heat tor for gains Feb I 0.81 0 I temperatu 20.43 20	ature (ting pe s for li Mar 0.72 re in li 0.68	heating seaso priods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97	on) ving m (s v (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21	ble 9, Tl Aug 0.24 7 in Tab 21	h1 (°C) Sep 0.4 le 9c) 20.98	Oct 0.64 20.84	Nov 0.81 20.52	Dec 0.88 20.19		(85) (86) (87)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m=	ean inter perature ation fac Jan 0.87 interna 20.24 perature 20.35	nal tempera during heat tor for gains Feb I 0.81 0 temperature 20.43 20 during heat 20.35 20	ting personal statements for library for library for library for the second statement of the second st	heating seaso eriods in the li ving area, h1, Apr May 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36	on) ving m (s y (follo	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Ta	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, T	h1 (°C) Sep 0.4 le 9c) 20.98 Fh2 (°C) 20.36	Oct 0.64 20.84	Nov 0.81 20.52	Dec 0.88 20.19		(85) (86) (87) (88)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m=	an inter perature ation fac Jan 0.87 interna 20.24 perature 20.35	nal temperaduring heattor for gainsFeb0.8101 temperatu20.4320.4320.3520.35	ting personal statements for library for l	heating sease eriods in the li ving area, h1, Apr May 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36	on) ving m (s (follc (follc	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Ta 20.36 20.36	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, 1 20.36	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36	Oct 0.64 20.84 20.36	Nov 0.81 20.52 20.36	Dec 0.88 20.19 20.35		(85) (86) (87) (88)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (80)m=	an inter perature ation fac Jan 0.87 0.87 0.87 0.87 0.87 0.87 0.87 0.87	nal tempera during heat tor for gains Feb I 0.81 0 I temperatu 20.43 20 during heat 20.35 20 tor for gains	ting personal for the second s	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling	0n) ving (follc (follc (follc (follc (follc (follc (follc) (follc) (follc)	area from Talee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 /elling from Ta 20.36 20.36 ,m (see Table	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, 1 20.36 9 a)	h1 (°C) Sep 0.4 le 9c) 20.98 Fh2 (°C) 20.36	Oct 0.64 20.84 20.36	Nov 0.81 20.52 20.36	Dec 0.88 20.19 20.35		(85) (86) (87) (88)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m=	an inter perature ation fac Jan 0.87 interna 20.24 perature 20.35 ation fac 0.85	nal temperaduring heattor for gainsFebI0.8101 temperatur20.4320during heat20.3520tor for gains0.80.80	ature (ting pe s for li Mar 0.72 re in li 0.68 ting pe 0.35 s for re 0.7	heating sease eriods in the living area, h1, Apr May 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38	on) ving m (s y (follc (follc (follc 2 1, h2	area from Talee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Ta 20.36 20.36 ,m (see Table 0.25 0.18	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, T 20.36 9 a) 0.2	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36	Oct 0.64 20.84 20.36 0.61	Nov 0.81 20.52 20.36 0.79	Dec 0.88 20.19 20.35 0.87		(85) (86) (87) (88) (89)
7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m= Mear	an inter perature ation fac Jan 0.87 interna 20.24 perature 20.35 ation fac 0.85	nal tempera during heat tor for gains Feb I 0.81 0 I temperatur 20.43 20 during heat 20.35 20 tor for gains 0.8 0.8	ature (ting pe s for li Mar 0.72 re in li 0.68 ting pe 0.35 s for re 0.35 re in t	heating sease eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwe	on) ving m (s / (follo (follo) (follo) (follo) (follo) (follo)) (follo))))))))))))))))))	area from Ta ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Ta 20.36 20.36 ,m (see Table 0.25 0.18 T2 (follow step	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, 1 20.36 9 a) 0.2 eps 3 to	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 0.36 7 in Table	Oct 0.64 20.84 20.36 0.61 0.61	Nov 0.81 20.52 20.36 0.79	Dec 0.88 20.19 20.35 0.87		(85) (86) (87) (88) (89)
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7. Me Temp Utilisa (86)m= Mear (87)m= Temp (88)m= Utilisa (89)m= Mear (90)m= Mear (90)m= Mear (92)m= Apply (93)m= 8. Sp	an inter perature ation fac Jan 0.87 0.87 0.87 0.87 0.87 0.20.24 0erature 20.35 ation fac 0.85 0.85 0.85 0.85 0.85 0.85 0.85 0.85	nal tempera during heat tor for gains Feb I 0.81 0 1 temperature 20.43 20 during heat 20.43 20 during heat 20.35 20 tor for gains 0 0.8 0 temperature 19 19.61 15 19.94 20 nent to the r 19.94 19.94 20 ting require 19.94	ature (ting pe s for li Mar 0.72 re in li 0.68 ting pe 0.35 s for re 0.35 s for re 0.7 re in t 9.95 re (for 0.24 mean 0.24 mean 0.24	heating seaso eriods in the li ving area, h1, Apr Ma 0.56 0.41 iving area T1 20.88 20.97 eriods in rest of 20.36 20.36 est of dwelling 0.54 0.38 he rest of dwe 20.22 20.32 the whole dw 20.48 20.58 internal temp 20.48 20.58	on) ving m (s v (follo 2 v) ving (follo 2 v) velling velling velling	area from Tale ee Table 9a) Jun Jul 0.28 0.2 ow steps 3 to 20.99 21 velling from Tale 20.36 20.36	ble 9, Tl Aug 0.24 7 in Tab 21 able 9, T 20.36 9a) 0.2 eps 3 to 20.36 + $(1 - f$ 20.62 + $4e$, wh 20.62	h1 (°C) Sep 0.4 le 9c) 20.98 Th2 (°C) 20.36 7 in Table 20.34 ft LA) × T2 20.6 lere appro 20.6	Oct 0.64 20.84 20.36 0.61 20.17 20.17 A = Liv 20.44 priate 20.44	Nov 0.81 20.52 20.36 0.79 19.74 ing area ÷ (2 20.06 20.06	Dec 0.88 20.19 20.35 0.87 19.28 4) = 19.65 19.65	21 21 0.4	(85) (86) (87) (88) (89) (90) (91) (91) (92) (93)
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Utilisation factor for gains, hm:						
(94)m= 0.84 0.79 0.69 0.54 0.39 0.27 0.19 0.22	0.38	0.62	0.78	0.85		(94)
Useful gains, hmGm , W = (94)m x (84)m						
(95)m= 556.34 587.58 588.84 535.55 427.2 291.1 195.22 204.38	311.68	439.25	505.48	540.24		(95)
Monthly average external temperature from Table 8	1	i			1	
(96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m \times]])]	1- (96)m	492.04	607.76	760.66		(07)
(97) m = 705.07 740.33 000.02 509.25 435.02 292.02 195.52 204.9	$\frac{317.2}{(05)}$	102.91	1)m	762.00		(37)
$(98)m = 155.74 \ 106.68 \ 68.28 \ 24.27 \ 6.42 \ 0 \ 0 \ 0$	0	32.49	95.24	165.48		
Tota	al per year	(kWh/year	.) = Sum(9	8)15.912 =	654.6	(98)
Space heating requirement in kWh/m²/year			, ,		9.08	(99)
9b. Enerav requirements – Community heating scheme						_
This part is used for space heating, space cooling or water heating prov	vided by	a comm	unity scł	neme.		
Fraction of space heat from secondary/supplementary heating (Table 1	1) '0' if n	one	,		0	(301)
Fraction of space heat from community system $1 - (301) =$					1	(302)
The community scheme may obtain heat from several sources. The procedure allows for	CHP and	up to four	other heat	sources; ti	he latter	
includes boilers, heat pumps, geothermal and waste heat from power stations. See Appe Fraction of heat from Community heat pump	endix C.				1	(303a)
		(0)	20) (200			
		(3	UZ) X (303	a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community he	ating sys	tem			1	(305)
Distribution loss factor (Table 12c) for community heating system					1.05	(306)
Space heating					k <mark>Wh/y</mark> ear	-
Annual space heating requirement					654.6	
Space heat from Community heat pump	(98) x (3	04a) x (30	5) x (306) : `	=	687.33	(307a)
Efficiency of secondary/supplementary heating system in % (from Table	e 4a or A	ppendix	E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (3	01) x 100 -	÷ (308) =		0	(309)
Water heating					2242.24	7
If DHW from community cohomo:					2046.91	
Water heat from Community heat pump	(64) x (3	03a) x (30	5) x (306) :	=	2149.26	(310a)
Electricity used for heat distribution 0.0	× [(307a)(307e) + (310a)(310e)] =			(310e)] =	28.37	(313)
Cooling System Energy Efficiency Ratio					0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷	· (314) =			0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside					240.51	(330a)
warm air heating system fans					0	(330b)
pump for solar water heating					0	(330g)
Total electricity for the above, kWh/year	=(330a)	+ (330b) +	(330g) =		240.51	(331)
						-

Energy for lighting (calculated in A	ppendix L)			Γ	318.27	(332)
Electricity generated by PVs (Appe	endix M) (negative quantity)			-331.63	(333)
Electricity generated by wind turbin	ne (Appendix M) (negative	quantity)			0	(334)
10b. Fuel costs – Community hea	iting scheme					
	Fuel kWh/yea	ar	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a) x		4.24 × 0.0)1 =	29.14	(340a)
Water heating from CHP	(310a) x		4.24 × 0.0)1 =	91.13	(342a)
Pumps and fans	(331)		Fuel Price	01 = 🔽	31 72	(349)
Energy for lighting	(332)		13.19 × 0.0	 ⊃1 = [41.98	$\left \begin{array}{c} (350) \\ (350) \end{array} \right $
Additional standing charges (Table	9 12)		10.10		120](351)
	, 			L	120	
Item 1	gies		13.19 × 0.0	01 =	-43.74	(352)
Total energy cost	= (340a)(342e) + (345)	(354) =		Γ	270.23	(355)
11b. SAP rating - Community hea	ting scheme					
Energy cost deflator (Table 12)				Г	0.42	(356)
Energy cost factor (ECF)	[(355) × (356)] ÷ [(4) + 45	.0] =			0.97	(357)
SAP rating (section12)					86.48	(358)
12b. CO2 Emissions – Community	heating scheme					
		Ene <mark>rgy</mark> kWh/year	Emission fac kg CO2/kWh	tor E: k	miss <mark>ions</mark> g CO2/year	
CO2 from other sources of space a Efficiency of heat source 1 (%)	and water heating (not CHI If there is CHP u	P) sing two fuels repeat (36	63) to (366) for the secon	nd fuel	219	(367a)
CO2 associated with heat source 1	[(307]	o)+(310b)] x 100 ÷ (367t	b) x 0.52	=	672.23	(367)
Electrical energy for heat distribution	วท	[(313) x	0.52	=	14.72	(372)
Total CO2 associated with commu	nity systems	(363)(366) + (368)	(372)	=	686.95	(373)
CO2 associated with space heating	g (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from in	nmersion heater or instanta	neous heater (312	2) x 0.22	=	0	(375)
Total CO2 associated with space a	and water heating	(373) + (374) + (375)	=		686.95	(376)
CO2 associated with electricity for	pumps and fans within dwo	elling (331)) x	0.52	=	124.82	(378)
CO2 associated with electricity for	lighting	(332))) x	0.52	=	165.18	(379)
Energy saving/generation technolo Item 1	ogies (333) to (334) as app	licable	0.52 × 0.0	01 =	-172.12	(380)
Total CO2, kg/year	sum of (376)(382) =			Γ	804.84	(383)
Dwelling CO2 Emission Ra	te (383) ÷ (4) =				11.16	(384)
El rating (section 14)					90.79	(385)

13b. Primary Energy – Community heating scheme				
	Energy kWh/year	Primary factor	P.Energy kWh/year	
Energy from other sources of space and water heating (not CH Efficiency of heat source 1 (%) If there is CHP usin	IP) ng two fuels repeat (363) to	(366) for the second fu	uel 219	(367a)
Energy associated with heat source 1 [(307b)	+(310b)] x 100 ÷ (367b) x	3.07	= 3976.41	(367)
Electrical energy for heat distribution	[(313) x		= 87.08	(372)
Total Energy associated with community systems	(363)(366) + (368)(372)	= 4063.49	(373)
if it is negative set (373) to zero (unless specified otherwise,	see C7 in Appendix C)	4063.49	(373)
Energy associated with space heating (secondary)	(309) x	0	= 0	(374)
Energy associated with water from immersion heater or instant	aneous heater(312) x	1.22	= 0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =		4063.49	(376)
Energy associated with space cooling	(315) x	3.07	= 0	(377)
Energy associated with electricity for pumps and fans within dv	velling (331)) x	3.07	= 738.35	(378)
Energy associated with electricity for lighting	(332))) x	3.07	= 977.08	(379)
Energy saving/generation technologies Item 1 Total Primary Energy, kWh/year sum of (376)	(382) =	3.07 x 0.01 =	-1018.1 4760.82	(380) (383)

9.0 **APPENDIX 2 – OVERHEATING REPORT**



Agar Grove Estate Redevelopment

Summer Comfort & TM59 Assessment

Report

16th July 2019



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Engineer (Initials)	Role
SW	TM59 Assessment
GS	Engineer

CONTENTS

1	Exec	utive Summary5	5
2	Intro	duction7	7
2			_
3	Legis	lation and Guidance	5
	3.1	Part L1A: limiting the effects of heat gains in summer	3
	3.2	The London Plan	3
	3.2.1	Chapter 5 – London's Response to Climate Change, Section 5.8 (2016)	3
	3.2.2	Policy 5.4.3 Minimise the risk of new development overneating	5 2
	3.2.4	Climate Change Adaptation Section 5.47	3
	2 2	New draft London Plan (2018)	2
	3.3.1	9.2.10	ý
	3.3.2	Policy SI4 Managing heat risk)
	3.4	The Camden Local Plan 2017	ə
	3.4.1	Policy CC2 Adapting to Climate Change	9
	_		
4	Abou	It the buildings10)
	4.1	General)
	4.2	Cooling Strategy)
5	Meth	nodology12	2
	51	Selecting Sample Rooms: 12	,
	5.2		
	5.2	why were these rooms chosen r	ć
	5.3	TM59 Design Methodology	2
	5.3.1	Criteria (B) – ledrooms, kitchens and bedrooms.	5 2
	5.3.3	Corridors – Temperature should not exceed 28C for more than 3% of the total annual hours13	3
	5.4	Weather Data	3
	с. г. г.	Madalling Coffugeo	ว
	5.5	Niouenning Sojtwure)
6	Resu	lts14	ł
	6.1	Block I	1
	6.1.1	2020 Weather File	1
	6.1.2	2050 Weather File14	ł
	6.2	Block JKL	1
	6.2.1	2020 Weather File	ł
	6.2.2	2050 Weather File	\$
	6.3	Absent neighbour	5
7	How	we reached compliance16	5
	7.1	Variables tried	5



	7.2	Block I	16
	7.3	Block JKL	17
8	Reco	ommendations	19
	8.1	General	19
	8.2	Limiting Gains	19
	8.2.1	Solar	19
	8.2.2	2 Other gains	19
	8.3	Increasing Fresh Air	20
	8.4	Glazing and Blinds	21
	8.5	Future Climate Change adaptation	22
	8.5.1	Current design options:	22
	8.5.2	Puture design measures:	22
9	Conc	lusions	22
10) Appe	endix	23
	10.1	Modelled Spaces	23
	10.2	TM59 Standard Internal Gains and Occupancy Profiles	25
	10.3	Bibliography	25



<u>1</u> Executive Summary

Summer comfort is important in all occupied buildings, and with climate catastrophe leading to increasing temperatures, is critical to the long-term success of buildings. As a reference for Agar, a recent study found London's predicted 2050 climate is comparable to Barcelona's current climate (Bastin, 2019). As with any design that depends on human operation, and is influenced by behaviour outside the client and design team's control, there are risks, and ways to mitigate these risks. This report details design work carried out, with actions for the client and design team.

The design standards for residential summer comfort have advanced since the original design of Agar for planning, including the publication of CIBSE TM59 "Design methodology for the assessment of overheating risk in homes" in 2017 (referred to as TM59 from this point on). This has two criteria – daytime comfort for all rooms, and night-time comfort for bedrooms.

The summer comfort strategy for both buildings uses a combination of natural ventilation from opening windows and mechanical ventilation. This depends on assumptions, including how open windows are, how often they are opened, and how much heat is generated inside the building (from cooking, appliances etc.). It is particularly sensitive to window operation as a way of rejecting heat from the building, and providing passive cooling. This operation depends on the building occupants, but is also influenced by the design of the windows: how easy they are to operate, internal space planning etc.

TM59 Modelling has been carried out based on 10 apartments, which have been selected to represent the most onerous examples, including apartments higher up the buildings with more exposure to solar gains, and ground floor apartments with limited openings for security. This modelling has been carried out for current weather data (2020), and future weather data (2050). TM59 uses relatively high internal gains but also assumes windows are open a lot of the time when people are in, which is potentially optimistic. For example, windows are assumed to be open whenever a room is warmer than 22°C, and bedrooms are assumed occupied 24/7.

To achieve summer comfort for 2020 weather data the following are required – without them, there is a significant risk of overheating:

Block I summer comfort requirements

Windows able to open wide day or night, 100% area of typical window to be openable:

- Ground floor: 15° wide.
- First floor and above: windows: 45° wide
- First floor and above: balconies: 45° wide

Block JKL summer comfort requirements

Windows able to open wide day or night, 60% area of typical window to be openable:

- Ground floor: 15° wide.
- First floor and above: 45° wide

External solar shading to 5th floor apartments


ACTION 1

Design team and client to review and comment on Summer Comfort Requirements (tables above)

Assuming these requirements are met, the same tests have been run with predicted 2050 weather, and in this case both buildings fail both TM59 criteria. Solar heating is a significant contributor to overheating. Certain glazing, such as on Block JKL, goes to floor level with the lowest panes non-openable. These lowest panes add solar gains but relatively little to overall daylighting and do not aid natural ventilation, so we suggest omitting these. Please see section 8.2.1 for more detail.

ACTION 2

Architects to review options to omit fixed low level glazing

There are other aspects of the design that can help mitigate the risk of overheating, including:

Potential changes and design development for the current designs

Add blinds / shades / louvres

Ensure the internal space planning allows for opening of windows

Design windows so that they can be securely held open

Ensure windows are usable i.e. detailed so they are not too heavy to operate

Potential retrofit options

Providing solar control film to reduce solar gains

Including underfloor cooling: could be accommodated/retrofitted with some changes to the Dimplex Zeroth system

Adding cooling to the mechanical ventilation system: could be accommodated with some changes to the Dimplex Zeroth system and in-apartment ductwork

Fitting external shading / louvres to limit solar gains: window reveals could be designed to incorporate this

Ceiling fans

ACTION 3

Design team to review and comment on feasibility of incorporating above options in current design



2 Introduction

This report details the process and results of a CIBSE TM59 overheating study for Blocks I and JKL of the Agar Grove Development, Phase 1C. Agar Grove is a major development of circa 500 homes for the London Borough of Camden. Current and future weather data was used to understand the current level of overheating risk as well as potential future risks due to a changing climate. The process was iterative, testing various options to find the most suitable as well as to understand what measures may need to be taken to future proof the building against potential future climate scenarios.

It is important to note, although final results indicate rooms passing with the 2020 weather file, this is predicated on assumptions and values adjusted during iterations. Therefore it is important to read these assumptions to understand their feasibility or to consider some alternative measures which could be adopted.

	Assumptions	Value	Comments
	Year 2050 - Mechanical Cooling required	50W/m2	Cooling is applied. Hence, in this case there would need to be a retrofit of a mechanical cooling system in the future. Previous iterations tried lower cooling values (20, 30 and 40W/m2). Although some rooms passed at these lower values, 50W/m2 was required for all rooms to pass
	Ground floor glazing opening fraction	15%	Due to security – have contacted Camden Council for clarification on this and still awaiting a response
Both Buildings	U-Value - Glazing	0.85W/m2.K	Total, including frames
	U-Value - External Walls	0.2W/m2.K	
	U-Value - External Floors	0.2W/m2.K	
	U-Value - Roof	0.1W/m2.K	
	Infiltration	0.5ach	air changes per hour
	Stage D drawing Plans		
Disalui	Typical glazing opening fraction	50%	# excludes ground floor
BIOCK I	Metal rail ballustrades		# as opposed to glass etc which would limit air flow
	Typical glazing opening fraction 35		# excludes ground floor
Block JKL	Balcony glazing opening fraction 56		
	5th floor shading		# 5th floor only passes with addition of shading

Figure 1: Table of Assumptions



Figure 2: Block JKL 5th Floor Shading. 400mm deep shade required for bedroom, and shade to cover balcony on living/kitchen room corner





3 Legislation and Guidance

According to the Camden Borough's Energy Efficiency and Adaptation, "Natural light makes buildings more attractive, pleasant and energy efficient. Building layouts should be designed to maximise sunlight and daylight while taking into account other factors such as overheating and privacy." Hence the design process needs to strike the balance between beneficial solar gains (such as in colder seasons) and good daylighting versus the risk of overheating in summer.

3.1 Part L1A: limiting the effects of heat gains in summer.

It must be demonstrated by calculation that a minimum standard is met in terms of limiting overheating.

3.2 The London Plan

The Mayor of London has a legal duty to set out policies and proposals in this strategy for adapting to climate change and a duty to take action on climate change. The London Plan sets out risks associated with climate change as well as practical steps to mitigate this.

3.2.1 Chapter 5 – London's Response to Climate Change, Section 5.8 (2016)

"For development proposals the **early design stage is the most cost effective time** to incorporate relevant design and technological measures, enabling proposals to realise their full potential to reduce carbon dioxide emissions and adapt to climate change. Responding to climate change has to be an integral and essential part of the development process and not a set of 'bolt-ons' ".

3.2.2 Policy 8.4.3 Minimise the risk of new development overheating

"Developers will be required to **follow the cooling hierarchy** (see below) to reduce the risk of developments **overheating** and reduce the impact on the UHI effect through avoiding mechanical cooling where possible and promoting passive cooling measures. Where mechanical cooling is proposed, developers will need to consider the use of low global warming potential refrigerants to reduce harmful emissions."

3.2.3 Policy 5.9 Overheating and Cooling

Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following **cooling hierarchy**:

- 1. Minimise internal heat generation through energy efficient design
- 2. Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
- 3. Manage the heat within the building through exposed internal thermal mass and high ceilings
- 4. Passive ventilation
- 5. Mechanical ventilation
- 6. Active cooling systems (ensuring they are the lowest carbon options)

3.2.4 Climate Change Adaptation Section 5.47

The GLA is developing with the Chartered Institute of Building Services Engineers (CIBSE) guidance for developers to address the risk of overheating in buildings......**The Mayor encourages the use of this guidance in the preparation of development proposals.** Refer to Section 3.3.1.



3.3 New draft London Plan (2018)

3.3.1 9.2.10

As a minimum, energy strategies should contain the following information:

f. The results of dynamic overheating modelling which should be undertaken in line with relevant Chartered Institution of Building Services Engineers (CIBSE) guidance, along with any mitigating actions (see Policy SI4 Managing heat risk).

3.3.2 Policy SI4 Managing heat risk

9.4.3 Many aspects of building design can lead to increases in overheating risk, including high proportions of glazing and an increase in the air tightness of buildings. Single aspect dwellings are more difficult to ventilate naturally and are more likely to overheat, and should normally be avoided in line with Policy D4 Housing quality and standards. There are a number of low-energy-intensive measures that can mitigate overheating risk. These include solar shading, building orientation and solar-controlled glazing.

9.45 The Chartered Institution of Building Services Engineers (CIBSE) has produced guidance on assessing and mitigating overheating risk in new developments...**TM 59 should be used for domestic developments** and TM 52 should be used for non-domestic developments. In addition, TM 49 guidance and datasets should also be used to ensure that all new development is designed for **the climate it will experience over its design life.**

3.4 The Camden Local Plan 2017

3.4.1 Policy CC2 Adapting to Climate Change

This requires developments to be resilient to climate change. All development should adopt appropriate climate change adaptation measures such as:

d). measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floor space is required to demonstrate the above in a Sustainability Statement.



4 About the buildings

4.1 General

- Mae are the architects for Block I
- Hawkins Brown Associates are the architects for Block JKL

Both buildings follow a general north south axis and hence a large proportion of the glazing is on the east and west facades. This is generally difficult to shade effectively against summer sun. Block I has stepped in windows with columns and balconies whereas JKL has a mixture of balconies and 'winter gardens' which are within the thermal envelope.

4.2 Cooling Strategy

Both buildings are being designed to *Passivhaus* standards. The strategy is for high levels of insulation to avoid heat loss or gain via the external façade. In addition a mechanical ventilation system with heat recovery is proposed (MVHR). This will rely on relatively low flow rates of air which helps bring down energy usage associated with fans as well as a high heat recovery rate. The MVHR will have a summer bypass for the heat exchanger, allowing fresh air to be brought in not tempered when it will help cool the building in summer. During peak summertime temperatures, the system will operate as 'mixed mode' allowing the occupant to open windows as well as receive fresh air from the mechanical ventilation system.

In the modelling we accounted for both the fresh air from openable windows in addition to the mechanical ventilation rates assigned to each space. No mechanical cooling is proposed, instead relying on passive cooling aligning with the London Plan Cooling Hierarchy.





Figure 3: 3D Model from above



Figure 4: 3D Model showing adjacent buildings





5 Methodology

5.1 Selecting Sample Rooms:

Block I: 12 rooms modelled plus 5 integral corridors.





Figure 5: 3D IES Model

Refer to Modelled Spaces in the Appendix for plan drawings showing all selected rooms.

5.2 Why were these rooms chosen?

- Solar Gains The relative position of the sun is a major factor in the heat gain of buildings. The rooms chosen were typically those deemed to have high solar gains. In particular, those with south and west glazing which will experience long afternoon exposure to the sun's rays in combination with the heat already gained throughout the day from both solar and internal gains. As the buildings are surrounded by other high rise blocks, the top floors were expected to get the least overshadow from these adjacent buildings. Hence South-Westerly apartments on the top floors were modelled.
- Security As the strategy includes natural ventilation via openable windows, the lower floors were assumed to need security measures which will restrict how much the windows can be opened. Hence ground floor apartments were modelled.
- Asymmetry As the top floor levels were not the exact layout as lower floors, some typical mid-level (3rd floor) apartments were modelled.
- Single sided ventilation Where there was no possibility for cross flow from openings on adjacent facades there was a greater risk of insufficient fresh air flow rates to expel heat gains

5.3 TM59 Design Methodology



CIBSE TM59 Design Methodology for the assessment of overheating risk in homes is a standard approach using dynamic thermal analysis and the guiding framework of the calculations and this report.

TM59 gives two criteria, both of which must be met for the space to have passed. In addition corridors should be analysed if there is a deemed risk. Refer to TM59 for full definitions but a basic summary is:

5.3.1 Criteria (a) – living rooms, kitchens and bedrooms.

Primarily focused on the need to ensure the internal temperature does not exceed the adaptive temperature for more than 3% of occupied hours. The adaptive temperature is dependent on the external temperature as it is deemed that occupant's subjective feeling of comfort inside a building is based on external temperatures and humidity levels. For example, if the external temperature is high, say 28°C, then occupants will be satisfied with a higher internal temperature than if the external temperature was 21.°C.

5.3.2 Criteria (B) – bedrooms only.

People tend to prefer cooler temperatures for sleeping, and so there is an additional standard for bedrooms during the typical sleeping hours (10pm to 7am) by ensuring the temperature does not exceed 26C for more than 1% of annual hours.

5.3.3 Corridors – Temperature should not exceed 28C for more than 3% of the total annual hours.

Unlike (a) and (b) this is not mandatory, but should be highlighted as a risk if a corridor does fail.

5.4 Weather Data

Two weather files were used. Both are design summer year (DSY1) datasets. The DSY1 data used represents a moderately warm summer year. It is used to evaluate overheating risk within buildings with a set of years which better describe overheating events, their relative severity and their expected frequency. It should be noted there is DSY 2 (short intense warm spells) and DSY 3 (long, less intense warm spell) weather data which were not used in this modelling.

- For current analysis: London_LWC_DSY1_2020High50.epw
- For adaptation for future climate, a year 2050 dataset was used: London_LWC_DSY1_2050High50.epw

5.5 Modelling Software

IES VE 2018 modelling software was used to build a 3D model, applying all data such as internal gains (as dictated by TM59) and applying the correct weather files, fabric values, glazing opening fractions, solar 'g' values and dimensions.



6 Results

6.1 Block I

6.1.1 2020 Weather File

All rooms pass both Criteria (a) and (b).

All integral corridors pass.

	May-Sept					
Top- Threshold Tadap>= 1	°C 24h	Top>26°C	Year 22pm - 7am		Top>280	2
>3%		>1%	•		>3%	
Room Name 💦 %	FAIL/PASS	%	FAIL/PASS/NA	FAIL/PASS		PASS/CAUTION
I.5.Apt.MW.Living/Kitchen 1.8%	PASS	-	N/A	PASS	-	-
1.5.Apt.MW.Corridor -	-	-	-	-	1.2%	PASS
I.5.Apt.MW.Bedroom 1.0%	PASS	0.7%	PASS	PASS	-	-
1.3.Apt.Living.SW 2.0%	PASS	-	N/A	PASS	-	-
I.3.Apt.Bedroom.SW 0.9%	PASS	0.8%	PASS	PASS	-	-
I.3.Apt.Corridor.SW -	-	-	-	-	1.1%	PASS
1.3.Apt.Living.SE 1.8%	PASS	-	N/A	PASS	-	-
I.1.Bedroom1.SW 0.8%	PASS	0.4%	PASS	PASS	-	-
I.1.Corridor.SW -	-	-	-	-	0.7%	PASS
I.1.Bedroom2.SW 0.7%	PASS	0.7%	PASS	PASS	-	-
I.GF.Living/Kitchen.SW 1.6%	PASS	-	N/A	PASS	-	-
I.3.Apt.Bedroom.MW 0.8%	PASS	0.9%	PASS	PASS	-	-
I.3.Apt.Corridor.MW -	-	-	-	-	1.3%	PASS
I.3.Apt.Corridor.SE -	-	-	-	-	1.0%	PASS
I.3.Apt.Bedroom1.SE 0.8%	PASS	0.8%	PASS	PASS	-	-
I.3.Apt.Living.MW 2.0%	PASS	-	N/A	PASS	-	-
I.GF.Living/Kitchen.SW 1.6%	PASS	-	N/A	PASS	-	-

Figure 6: Block I Table of Results

6.1.2 2050 Weather File

All rooms fail both criteria with the 2050 future weather file for passive cooling.

Next, active cooling was applied at 50W/m2 of floor area. All rooms then passed both Criteria (a) and Criteria (b).

The need for active (mechanical) cooling is not unsurprising for a future climate scenario of 2050. Once the external temperatures reach a certain threshold and maintain these high levels over longer periods of time, it is difficult to maintain a lower internal temperature. Options for this are discussed in section 8

6.2 Block JKL

6.2.1 2020 Weather File

All rooms pass both Criteria (a) and (b).

One integral corridor failed. As the corridors are not a mandatory part of passing, this report simply highlights this as a risk to consider. The model reflects the layouts of the time which included heat losses from a Dimplex Xeroth space heating and DHW unit along with associated pipework losses. To mitigate overheating risks where these are located, options include adding extract vents from the cupboard and/or insulating the cupboard.



BLOCK JKL	CRITE	RIA (a)	CRIT	TERIA (b)	Overall RESULTS	Integra	corridors/Halls		
Threshold	op-Tadap>= 1°	May-Sept 24h	Top>26°C	Year 22pm - 7am		Top>28	5		
	>3%		>1%			>3%			
Room Name	%	FAIL/PASS	%	FAIL/PASS/NA	FAIL/PASS	1	PASS/CAUTION		
JKL.5.Core C. West Bedroom	2.4%	PASS	0.4%	PASS	PASS	-	-		
JKL.5.Core C. West Corridor	-	-	-	-	-	4.5%	CAUTION		
JKL.GF.Core A.Corridor.SW	-	-	-	-	-	1.2%	PASS		
JKL.GF.Core A.Living.SW	2.4%	PASS	-	N/A	PASS	-	-		
JKL.1.Core A.Double Bed 1.SW	0.8%	PASS	0.4%	PASS	PASS	-	-		
JKL.1.Core A.Corridor.SW	-	-	-	-	-	0.9%	PASS		
JKL.1.Core A.Single Bed.SW	0.8%	PASS	0.7%	PASS	PASS	-	-		
JKL.1.Core A.Double Bed 2.SW	0.8%	PASS	0.6%	PASS	PASS	-	-		
JKL.3.SW Living/Kitchen	2.3%	PASS	-	N/A	PASS	-	-		
JKL.3.Core C. SW Corridor	-	-	-	-	-	1.1%	PASS		
JKL.3.Core C. SE Corridor	-	-	-	-	-	1.0%	PASS		
JKL.3.Core C. SW Bedroom	1.0%	PASS	0.4%	PASS	PASS	-	-		
JKL.3.Core C. SE Bedroom	1.1%	PASS	0.4%	PASS	PASS	-	-		
JKL.3.Core C. SE Living/Kitchen	2.2%	PASS	-	N/A	PASS	-	-		
JKL.5.Core C. West Living/Kitchen	2.5%	PASS	-	N/A	PASS	-	-		
JKL.5.Core B. Main block West 2nd Bedroom	1.5%	PASS	0.6%	PASS	PASS	-	-		
JKL.5.Core B. Main block West1st Bedroom	2.0%	PASS	0.7%	PASS	PASS	-	-		
JKL.5.Core B. Main block West Corridor	-	-	-	-	-	1.6%	PASS		
JKL.5.Core B. Main block West Living/Kitchen	2.9%	PASS	-	N/A	PASS	-	-		

Figure 7: Block JKL Table of Results

6.2.2 2050 Weather File

All rooms fail both criteria with the 2050 future weather file for passive cooling. Refer to 6.1 for more details.

6.3 Absent neighbour

Where a neighbour is away and therefore not opening their windows, there is a chance the overheating neighbouring apartment could cause overheating in the occupied apartment.

For both Block I and Block JKL modelling was carried out where 3rd floor south-east apartments were set as unoccupied to determine the added overheating risk to the 3rd floor south-west apartments.

		Criteria (a)		Criteria (b)						
Room	Standard Results	w/ absent neighbour	Difference %	Standard Results	w/ absent neighbour	Difference %				
I.3.Apt.Living.SW	2.0%	2.0%	0.0%		-					
I.3.Apt.Bedroom.SW	0.9%	0.9%	0.0%	0.8%	0.7%	-0.1%				
JKL.3.SW Living/Kitchen	2.3%	2.5%	0.2%		-					
JKL.3.Core C. SW Bedroom	1.0%	1.1%	0.1%	0.4%	0.5%	0.1%				

Figure 8: Absent Neighbour, Table of Results

The results show that an absent neighbour does add to the overheating risk. However in this scenario the increase was relatively small. It should be noted there are other scenarios where the affect may be larger, such as if a neighbour on the floor below is absent - larger ceiling/floor area between apartments means more heat transfer, typically two to three times as much, or if two neighbours are absent at the same time – summer holidays.



7 How we reached compliance

7.1 Variables tried

- 'g' values (decreasing limits the amount of solar radiation that can pass through glazing)
- Sill height
- Opening Fraction
- Shading
- Assuming occupant will close window if external temperature greater than 28C
- Redesign of rooms

7.2 Block I

In previous iterations, Block I was passing criteria (a) but some rooms failing (b) for the 2020 weather data.

Steps taken:

- 1. Changed 'g' value from 0.5 to 0.4 (keeping 30% free area glazing) Bedrooms still fail.
- 2. Changed the assumed typical free area from 30 to 50% (after discussion with the architects, Mae) All bedrooms in Block I then pass.





Agar Grove Estate Redevelopment Summer Comfort &

7.3 Block JKL

In previous iterations Block JKL had issues with the following:

• Ground floor: The small kitchen had high internal gains and limited openings due to the security issue.

Steps taken: Architect's updated layouts and relocated kitchen from the ground floor to the first. This resolved the issue of limited openings and the rooms then passed both criteria.

• Single sided bedrooms failing criteria (b) – night time.

Steps taken: Increased opening fraction of glazing from 30% to 35%. Rooms then passed.

• 5th floor living/kitchen failing due to being highly glazed and south west facing.

Steps taken:

- 1. Changed typical glazing free area from 35 to 50%:- still failing criteria (a) day-time comfort.
- 2. Reduced 'g' value from 0.5 to 0.35 still failing. Did not try reducing further than 0.35 due to the negative effects of lower annual solar gains and daylighting levels.
- 3. Raised sill height and in doing so decreased window area Results: Still failing, minimal improvement (probable the reduced solar gains are offset by reduced fresh air rates). It is important to note this is different from removing the bottom pane when the bottom pane is non-opening anyway. In that case, the opening fraction will stay the same but reduce the solar gain, which is desirable.
- 4. Added shading. For the living/kitchen spaces achieved by adding a shade over the 'cut corner' area. For the bedroom, a 400mm deep shade directly over the windows.
 Results: Rooms now pass. See Figure 10 below.



Figure 10: JKL Required Shading, 5th Floor







Figure 11: Block JKL Previous failing rooms



8 Recommendations

8.1 General

Camden Borough's planning guidance gives some examples to limit internal gains, which will in turn reduce overheating:

- Energy Efficient lighting
- Use smaller windows on the south elevations and larger on the north.
- Include high performance glazing

8.2 Limiting Gains

8.2.1 Solar

The lower pane is generally non-opening, meaning it contributes to solar gains but does not add to fresh air rates. In addition this lowest pane, being at floor level, only has a marginal effect on daylighting. We recommend removing this pane.



Figure 12: Illustration showing how lower pane allows little useful daylight while contributing to solar gains

8.2.2 Other gains

In this study we have focused on limiting solar gains and increasing fresh air rates to reduce the risk of overheating. Another option is to reduce internal gains. For the analysis this will not have an effect because the values used are dictated by TM59. However in reality we have the option of reducing these by good design.

Annually, solar gains only account for 30% of all gains, occupancy for 25% and 45% from equipment and lighting. The solar gains increase to 70% of all gains on a typical hot summer midday.





Figure 13: Annual and typical peak Heat Gains

Figure 13 above indicates it is worthwhile limiting equipment and lighting gains. For the analysis this will not have an effect because the values used are dictated by TM59. However in reality we have the option of reducing these by good design.

Generally speaking the more efficient a product the less energy is required to run it. Typically that energy is released as excess heat, contributing to heat gains. Hence by selecting energy efficient equipment, such as A++ rated fridges, induction hobs, high efficacy lighting and applying good insulation on mechanical pipework we can reduce these heat gains. Figure 14 below breaks down internal gains, showing lighting, audio-visual and cooking to be some of the biggest contributors.



Figure 14: Average 24-hour profile for 250 homes (source: DECC, 2013)

8.3 Increasing Fresh Air

Iterations have shown that reducing solar gains helps reduce the overheating risk, but in general is not always enough, due primarily to the fact that solar gains only account for a proportion of all the gains. Reducing glazing dimensions was shown to limit solar gains but also limited the fresh air rate available which was a net negative.

The variable that drove the largest improvement was increasing the openable fraction of the glazing. This is due to rooms requiring large fresh air rates, and this is not only driven by solar gains but also by internal gains.





Figure 15: Side hung VS bottom hung windows – Side hung generally allow a greater opening fraction but are a greater security risk. This can be mitigated by including limiting locks which can be overridden by the occupants when security risk is low and overheating risk is high, such as a summer day when occupants are home. The best option is generally tilt and turn, allowing both options.

8.4 Glazing and Blinds

If adopting internal blinds that move with the glazing, outward opening glazing allows more heat to escape while still blocking the sun.



Figure 16: Integral blinds

If blinds are not integral they can restrict air flow:





Figure 17: Blinds vs glazing





8.5 Future Climate Change adaptation

Both buildings current passive cooling design is insufficient in keeping the overheating level to within an acceptable level given the 2050 DSY future climate scenario and assumptions in the TM59 protocol. In the modelling we demonstrated that applying 50W/m2 cooling was required. There are also passive measures which, when applied in combination, may be enough to mitigate the overheating risk. Failing that, these passive measures may reduce the mechanical cooling load to below 50W/m2.

Below is a list of design features which could either be implemented now or adopted later on.

8.5.1 Current design options:

- Include external blinds
- Include internal blinds integral to glazing
- Add more external shading
- Remove lower glazing panes which are unopenable
- Make glazing 'tilt and turn' type
- Limit internal gains by using better than industry standard insulation on pipework and limiting heat losses from HIUs
- Add louvres this will increase fresh air rates to help mitigate heat gains. In addition louvres are secure and can be left open while windows need to be closed due to security risks
- Underfloor Cooling (UFC) At present underfloor heating (UFH) is proposed. Ensuring this type of system is adopted as opposed to, say, a radiator ensures the possibility of adapting the UFH to also provide cooling (UFC). This would not be possible with a radiator system because of the larger surface areas required for UFC. It should be noted UFC is unlikely to be able to provide 50W/m2 of cooling (more typically 7W/m2). However this should still be considered as, in combination with other passive measures listed, could be effective.

8.5.2 Future design measures:

- Retrofit mechanical cooling see 'current design options' above
- Retrofit blinds internal or external, see 'current design options' above
- Retrofit glazing with screen with lower 'g' value

9 Conclusions

The results have shown that if we adopt the assumptions laid out in this report ('g' values, shading on JKL 5th floor and high opening fractions of glazing) then the risk of overheating is limited to within an acceptable level according to TM59.

The results for the future climate adaptation show the need for further discussion on the best approach to mitigate this, whether that is by installing underfloor heating for the ability to adapt this to underfloor cooling later on; to enhancing passive design features now or ensuring the possibility of retrofitting these should the predicted climate become reality.



10 Appendix

10.1 Modelled Spaces



Agar Grove Estate Redevelopment Summer Comfort &







10.2 TM59 Standard Internal Gains and Occupancy Profiles

Number	Description	Peak lo	ad (W)												Per	riod											
of people		Sensible	Latent	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
				Hour-ending																							
				1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00
1	Single bedroom occupancy	75	55	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.7
2	Double bedroom occupancy	150	110	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.7
2	Studio occupancy	150	110	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1-bed: living/kitchen occupancy	75	55	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
1	1-bed: living occupancy	75	55	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0
1	1-bed: kitchen occupancy	75	55	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0
2	2-bed: living/kitchen occupancy	150	110	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
2	2-bed: living occupancy	150	110	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0
2	2-bed: kitchen occupancy	150	110	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0
3	3-bed: living/kitchen occupancy	225	165	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
3	3-bed: living occupancy	225	165	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0
3	3-bed: kitchen occupancy	225	165	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0
	Single bedroom equipment	80		0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.13
	Double bedroom equipment	80		0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.13
	Studio equipment	450		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	1	1	0.44	0.44	0.24	0.24
	Living/kitchen equipment	450		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	1	1	0.44	0.44	0.24	0.24
	Living equipment	150		0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	1	1	1	1	0.4	0.4
	Kitchen equipment	300		0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	1	1	0.17	0.17	0.17	0.17

Figure 18: Heat Gain Profile, taken from TM59

10.3 Bibliography

Bastin, J.-F. (2019). Understanding climate change from a global analysis of city analogues. PLOS.



