

28 AVENUE ROAD, ST JOHNS WOOD, LONDON NW8

ENERGY AND SUSTAINABILITY STATEMENT

JB/682: March 2021

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28 AVENUE ROAD, ST JOHNS WOOD, LONDON NW8

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INTRODUCTION

Our client is applying for planning permission to construct a new family home and as part of the process; he is taking the opportunity to significantly enhance its sustainability; including the potential for renewable technologies. 28 Avenue Road is proposed is to be constructed as a sustainable low carbon house, finished to a high quality and standard.

This report has been prepared by ME7 Ltd, to demonstrate how the development will achieve a low carbon status and covers the proposed sustainable design measures related to the building fabric and mechanical and electrical services.

The proposed building has been modelled using an accredited calculation methodology (SAP 2012) and by an accredited energy assessor. Through use of appropriate passive and building fabric design as key points/measures below and energy saving measures, it is shown that the building will release lower net annual CO₂ emissions against baseline levels and satisfies the current Building Regulation Part L, The Adopted London Plan requirements and Camden Energy efficiency and adaption policies requirements.

Key points/measures proposed:

- A CO₂ reduction of 53% (Cumulative), for the site over the baseline; confirming that the proposed refurbished dwelling exceeds the requirements of the Camden Energy efficiency and adaption 2019, The Adopted London Plan 2016 and the National Planning Policy Framework.
- 17.094 tonnes of CO2 saving per annum for the site over the baseline.
- Zero NOx emissions for the GSHP system and low NOx emissions from efficient backup heating plant, complying with the Adopted London Plan.
- Reusing/recycling and salvage existing materials where possible.
- Reducing water consumption through rainwater harvesting and flow restrictors.
- Utilisation of natural shading, orientation and planting.
- Fully insulating/ providing double glazed windows to the new elements low U values.
- Air tightness of 4.0m3/m2/hr@50Pa.
- Heat recovery ventilation to the lower ground floor (lower) area 80% efficiency.
- New materials to be responsibly sourced and life cycle reviewed.
- Inclusion of a renewable energy system (GSHP) and a renewable energy system (PV).
- Data logging/internal digital metering/control for efficient management of the building.

Owing to the above improvements over the minimum Part L requirements, the PEA (Predicted Energy Assessment – Outline EPC) for the proposed refurbished building is an energy efficiency rating of Grade B (87) and a CO2 impact rating of Grade B (87).

Included within the report is an appraisal of various renewable technologies, demonstrating their viability and appropriateness to the environment and nature of the development.

It is proposed that a GSHP system (COP 5.08), will be suitable for providing 90% of the yearly heating demand. With gas boilers for providing heating and domestic hot water production top up and backup only. This combination will significantly reduce CO2 emissions and be well matched to the building. Apart from the GSHP and PV systems proposed, other renewable sources are not effective or suitable for the building.

Heat gains have been reduced with passive measures; building orientation, tree shading, concrete slabs/ brick facades, internal blinds, high performance glazing and passive/ MVHR ventilation. Where cooling is proposed, this is only to some parts of the house and only at peak times. This will be provided by a renewable source, a vertical borehole GSHP system based on high efficiency water cooled condensors with a high efficiency EER of 5.84 for cooling.

A detailed description of the proposed electrical and mechanical systems is also included within the report, detailing the energy efficient and sustainable design measures to be incorporated.

Full assessment modelling/calculations/reports demonstrating compliance, including energy statement, SAP L1A and PEA (Pre-EPC); can be found in the main sections and appendices of this report. The M&E proposals outlined in this report are in line with the Adopted London Plan 2016, the National Planning Policy Framework, Camden Energy efficiency and adaption 2019 and Building Regulations.

Section 1.0

RENEWABLE ENERGY STATEMENT

ME7 LTD Jorand House Bebington Close Billericay Essex, CM12 0DT

ASSESSMENT INFORMATION

Prepared by: Ondrej Gajdos, ME7 Ltd

Date: 08 March 2021

DISCLAIMER

The findings, conclusions and recommendations of this report are based on the information supplied. ME7 Ltd disclaims responsibility in respect of incorrect information imparted to them or for the actual performance of any of the building services installations.

This Report is prepared for the construction of a new house at 28 Avenue Road; a duty of care is not owed to other parties.

EXECUTIVE SUMMARY

ABOUT THE ENERGY STATEMENT

ME7 Ltd have been appointed to provide an Energy Statement for the proposed development.

This statement covers possible active and passive measures including renewable energy sources to make this development sustainable and environmentally friendly.

Baseline and all estimated energy consumptions have been calculated using full SAP 2012 assessment of the development in accordance with Part L procedures and SAP 10 emission factors in line with the latest GLA planning guidance.

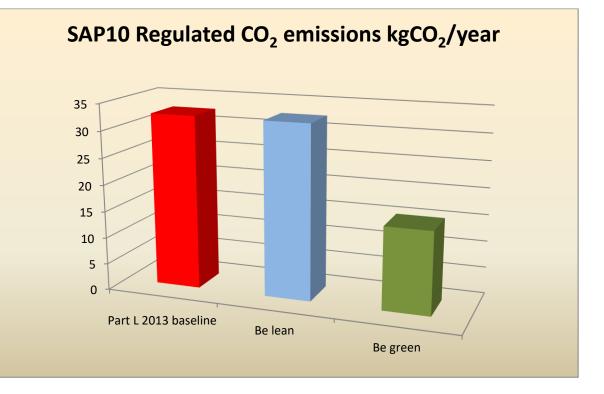
The tables below show a summary of energy requirements for baseline scheme and reduction proposed to be achieved by passive measures, efficient services and on-site renewable energy sources.

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO ₂ per annum)				
	Regulated	Unregulated			
Baseline: Part L 2013 of the					
Building Regulations Compliant	32.6	4.6			
Development					
After energy demand reduction	32.5	4.6			
After renewable energy	15.4	4.6			

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic building

	Regulated domestic carbon dioxide savings					
	(Tonnes CO ₂ per annum)	(%)				
Savings from energy demand reduction	0.040	0.1%				
Savings from renewable energy	17.094	52%				
Cumulative on site savings	17.140	53%				



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Table 3: SAP calculation specification for each stage of the energy hierarchy

Specification Notional Baseline		Efficient Baseline (Be Lean)	Proposed Development (Be Green)
External Wall U-value	0.18	0.18	0.18
Ground floor	0.13	0.12	0.12
Roof U-value	0.13	0.12	0.12
Windows U-value	1.50	1.30	1.30
Thermal bridging	Accredited construction details throughout		Accredited construction details Sthroughout, lintels with psi-value of 0.05 rW/mK (e.g. Keystone Hi Therm lintels or similar)
Air Permeability	5	4	4
Main Heating System	Condensing gas boiler, SEDBUK 2009 efficiency 88%, underfloor heating, programmer and at least 2 room thermostats	6	, GSHP with wet underfloor heating, assumed to provide 90% of heat demand tbacked up by gas boiler (10% of demand
Secondary heating		Gas fires with 80% efficiency	Gas fires with 80% efficiency
DHW System	Condensing gas boiler, SEDBUK 2009 efficiency 88%,	2No 1,000L Heatrae Sadia Megaflo commercial, fed from the main heating system	2No 1,000L Heatrae Sadia Megaflo commercial, fed from the main heating system
Cooling system	-	GSHP system with seasonal cooling SEE of 5.0 or higher	GSHP system with seasonal cooling SEER of 5.0 or higher
Ventilation System	Natural with intermittent mechanical extracts	Natural with intermittent mechanical extracts	Natural with intermittent mechanical extracts
Energy Efficient Lighting	75%	100%	100%
Renewable energy sources			PV system with total peak output of 4.4kWp, e.g. 11 No PV panels Sunpower Maxeon 400, installed horizontally on the flat roof
% Improvement in CO2 over Building regulations compliant baseline	0.0%	0.1%	53%

The proposed house will achieve:

- 52% reduction in regulated CO2 emissions by renewable sources (PV system and GSHP)
- 53% reduction in regulated CO2 emissions compared to 2013 Part L1A notional baseline

All CO2 reductions are calculated using SAP10 emission factors $% \left({{{\rm{S}}}_{{\rm{A}}}} \right)$

Energy consumption of the proposed house

									SAP10 CO2 P	ERFORMANCE
DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS										
Unit identifier	Model total	REGULATED	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE GREEN' SAP DER WORKSHEET REGULATED CO2 EMISSIONS PER UNIT							
(e.g. plot number, dwelling type etc.)	floor area (m²)	Space Heating (Heat Source 1)	Heat Source 1) Water (Heat source 2) generated by						SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
28 Avenue Road	2525.6	34679	5142	30312	-3346	2871	105	24	15,445	6.1

INTRODUCTION

BACKGROUND

ME7 Ltd have been appointed to provide an Energy Statement for the proposed development.

This statement covers possible active and passive measures including renewable energy sources to make this development sustainable and environmentally friendly.

DESCRIPTION OF THE DEVELOPMENT

Construction of a new 11-bedroom house arranged over basement, ground, $1^{st}\,and\,2^{nd}$ floor.



PLANNING FRAMEWORK

NATIONAL POLICY

DCLG sets out basis for local policies in section 14 of National Planning Policy Framework. It requires new development to be planned in ways that can help to reduce greenhouse gas emissions, such as through its location, orientation and design. To help increase the use and supply of renewable and low carbon energy and heat, plans are encouraged to:

a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

BUILDING REGULATIONS 2013 PART L1A

Part L1A sets out 3 main criteria for energy efficiency in newly constructed dwellings:

- CO2 emissions from the proposed dwellings, i.e. Dwelling Emission Rate (DER) has to be lower than the Target Emission Rate (TER)
- Dwelling Fabric Energy Efficiency has to be lower than the Target Fabric Energy Efficiency
- Risk of overheating has to be assessed using SAP appendix P

THE ADOPTED LONDON PLAN

The Adopted London Plan is the name given to the Mayor's spatial development strategy. The current version of the Adopted London Plan was published in 2011 with Further Alterations to the Adopted London Plan published in March 2016. The aim is to develop London as an exemplary sustainable world city, based on three interwoven themes.

- 1. Strong, diverse long term economic growth
- 2. Social inclusivity to give all Londoners the opportunity to share in London's future success
- 3. Fundamental improvements in London's environment and use of resources.

Specific requirements on development sustainability are set out in the following policies:

POLICY 5.2 MINIMISING CO2 EMISSIONS

Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

- 1. Be lean: use less energy
- 2. Be clean: supply energy efficiently
- 3. Be green: use renewable energy

Policy 5.6 – Decentralised Energy in Development Proposals

Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites. Major development proposals should select energy systems in accordance with the following hierarchy:

- 1. Connection to existing heating or cooling networks
- 2. Site wide CHP network
- 3. Communal heating and cooling

Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

POLICY 5.7 – RENEWABLE ENERGY

The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London. Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible. There is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20 per cent through the use of on-site renewable energy generation wherever feasible.

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)

ZERO CARBON POLICY

As outlined in the Housing SPG, from 1 October 2016 the Mayor applies a zero carbon standard to new residential development. The Housing SPG defines 'Zero carbon' homes as homes forming part of major development applications where the residential element of the application achieves at least a 35 per cent reduction in regulated carbon dioxide emissions (beyond Part L 2013) on-site . The remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere (in line with policy 5.2E). This payment is currently fixed (in most boroughs) at £60/tonne of CO₂ per year for 30 years.

As the proposed development comprises less than 10 newly constructed dwellings, it is not considered a major development in accordance with the Adopted London Plan definitions. The zero carbon policy, policies 5.2, 5.6 and 5.7 are therefore not applicable.

BASELINE ENERGY CONSUMPTION & CO2 EMISSIONS

Energy assessment using SAP 2012 has been carried out on the actual proposed dwellings using notional baseline specification achieving compliance with 2013 Part L. The specification is set out in Table 3 above.

The notional baseline is based on 2013 Part L1A notional building for calculating Target Emission Rate (TER)

		SAP10 CO2 PERFO	RMANCE				
DOMESTIC EN		JMPTION A	ND CO2 AN	ALYSIS			
		REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - TER WORKSHEET			REGULATED CO2 EMISSIONS PER UNIT		
Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Space Heating	Domestic Hot Water	Lighting	Auxiliary	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated TER SAP10 (kgCO2 / m2)
28 Avenue Road	2525.6	146768	5129	2871	75	32,585	12.9

BE LEAN: PASSIVE MEASURES AND EFFICIENT SERVICES

Number of passive design measures and measures improving energy efficiency of building services have been included in the design to help to reduce the CO2 emissions, including:

- Newly constructed elements with U-values going beyond the building regs requirement
- High efficiency condensing boiler
- 100% low energy lights

Full specification of the efficient baseline is described in Table 3.

							SAP10 CO2 P	ERFORMANCE
DOMESTIC E		UMPTION A	ND CO2 AN	ALYSIS				
Unit identifier		REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE LEAN' SAP DER WORKSHEET				REGULATED CO2 EMISSIONS PER UNIT		
(e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Space Heating	Space Heating Domestic Hot Lighting Auxiliary Cooling Water					Calculated DER SAP10 (kgCO2 / m2)
28 Avenue Road	2525.6	146623	5055.05	2871.02	75	24.0	32,544	12.9

OVERHEATING AND COOLING

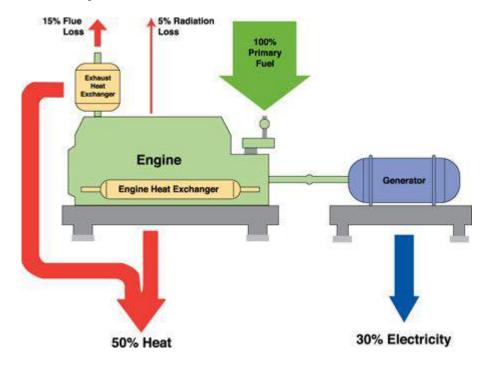
The house has also been assessed against overheating criteria set out in SAP Appendix P.

The house complies with the criteria using passive measures openable windows. Mechanical cooling is also proposed for the development.

BE LEAN: COMBINED HEAT AND POWER

GENERAL INFORMATION

Although not using any renewable energy source, gas CHP helps to reduce CO2 emissions by delivering heat and electricity locally and reducing the losses that normally occur by conventional power plants. Produced electricity can be exported to grid if the on-site demand is lower than production.



RECOMMENDATIONS SPECIFIC TO THIS DEVELOPMENT

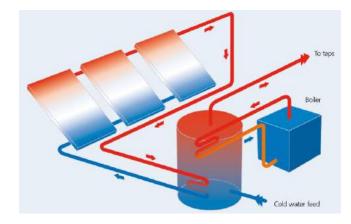
Due to significant de-carbonisation of the grid electricity in the recent years and further decarbonisation expected in near future, gas CHP is no longer beneficial in terms of CO2 reduction. It is therefore not proposed for the development.

BE GREEN: ON-SITE RENEWABLE ENERGY SOURCE – SOLAR HOT WATER (SHW)

GENERAL INFORMATION

Solar hot water systems for dwellings use collector which provides a separate heating circuit for hot water cylinder. This is usually backed up by electric immersion heater or other source of heat.

- Two types of collectors are available:
- Flat Plate less expensive, less efficient
- Evacuated Tube more expensive and more efficient





RECOMMENDATIONS SPECIFIC TO THIS DEVELOPMENT

Solar hot water system has been ruled out due to relatively low hot water demand compared to space heating and lower CO2 reduction potential compared to solar photovoltaic. BE GREEN: ON-SITE RENEWABLE ENERGY SOURCE – AIR SOURCE HEAT PUMP (ASHP)

GENERAL INFORMATION

An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside. It can extract heat from the air even when the outside temperature is as low as minus 15° C.

On 17 December 2008, the European Parliament adopted the EU Directive on promoting the use of energy from renewable sources. For the first time however, in addition to geothermal energy, aerothermal and hydrothermal energy are also recognised as renewable energy sources.

There are two main types of ASHP:

AIR-TO-WATER SYSTEM

Air-to-water system uses the heat to warm water. Heat pumps heat water to a lower temperature than a standard boiler system would, so they are more suitable for underfloor heating systems than radiator systems. Although some ASHP systems are capable of heating the water to the higher temperature, the efficiency is higher when using low temperature underfloor heating or low temperature fan convectors.





AIR-TO-AIR SYSTEM

Air-to-air system uses the heat to warm the indoor air. The air is heated through individual fan-coils or centrally and then distributed to rooms via ductwork.



RECOMMENDATIONS SPECIFIC TO THIS DEVELOPMENT

Air source heat pumps have been considered, however have been ruled out due to lower efficiency compared to ground source heat pump, as well as potential problems with noise from the outdoor unit.

BE GREEN: ON-SITE RENEWABLE ENERGY SOURCE – SOLAR PHOTOVOLTAICS (PV)

GENERAL INFORMATION

This system uses semi-conductor cells to convert solar energy into electricity. Two main types of PV panels are available: - Monocrystalline – More expensive and more efficient - Polycrystalline – Less expensive and less efficient

- I offer ystannie – Less expensive and less encient

Depending on type, the output of 1 kWp (kilowatt peak) can be achieved by panels with area between 5 and 20 m2.

The use of PV panels generally requires relatively large unshaded roof area where they can be mounted facing south, ideally having between 15° and 35° inclination.



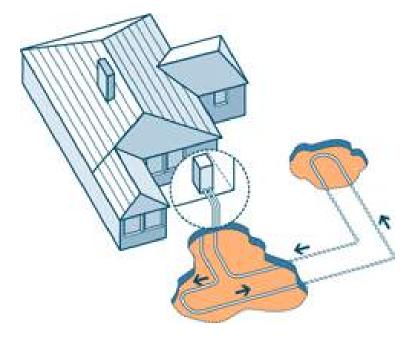
RECOMMENDATIONS SPECIFIC TO THIS DEVELOPMENT

It is proposed to install a PV system with a total peak output of 4.4 kWp with horizontally mounted PV panels on the inner roof slopes. An example of this system would be 11 No PV panels Sunpower Maxeon 400. BE GREEN: ON-SITE RENEWABLE ENERGY SOURCE – GROUND SOURCE HEAT PUMP (GSHP)

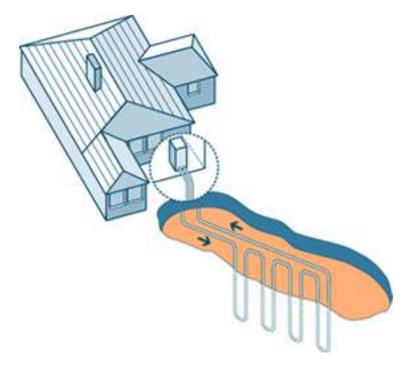
 $General \ information$

Ground source heat pumps use a buried ground loop which transfers heat from the ground into the building through heating distribution system. GSHP technology can be used both for heating and cooling. Two main types of GSHP are available:

- Horizontal loop is suitable for applications where sufficient area is available to accommodate horizontally buried pipes



- Vertical loop system can be used where ground space is limited, but will require boreholes typically 15-150m deep, and is consequently more expensive to install than horizontal systems.



RECOMMENDATIONS SPECIFIC TO THIS DEVELOPMENT

It is proposed to install a closed loop vertical borehole ground source heat pump system which will serve as the main heating system through wet underfloor heating, as well as a part cooling source. It will be backed up by high efficiency gas fired boilers for the heating systems. BE GREEN: ON-SITE RENEWABLE ENERGY SOURCE – BIOMASS/ BIOFUELS

GENERAL INFORMATION

Producing energy from biomass has both environmental and economic advantages. It is a carbon neutral process as the CO2 released when energy is generated from biomass is balanced by that absorbed during the fuel's production.

There are two main ways of using biomass to heat a domestic property:

- Standalone stoves providing space heating for a room. These can be fuelled by logs or pellets but only pellets are suitable for automatic feed. Generally they are 6-12 kW in output, and some models can be fitted with a back boiler to provide water heating.

- Boilers connected to central heating and hot water systems. These are suitable for pellets, logs or chips, and are generally larger than 15 kW.

RECOMMENDATIONS SPECIFIC TO THIS DEVELOPMENT

Biofuels are ruled out due to negative impact on air quality and environmental issues surrounding liquid biofuels as currently there are no established standards relating to the sustainability of biofuels.

WATER	
	Internal Water consumption will be reduced by specification of water efficient fittings. The water consumption will be reduced to 105 litres per person per day or less by specifying water fittings with the following parameters:
	WC's: All dual flush capacity 3/6 Litres or less Kitchen taps flow aret: 6 l/min or less Bathroom taps flow rate: 5 l/min or less Bath capacity to overflow: 140 l or less Showers flow rate: 9 l/min or less Dishwasher consumption: 0.5 Litres per place setting or less Washing machine consumption: 5.5 litres per kg dry load or less
Materials	Environmental impact of construction materials will be taken into account. Where possible, construction materials will be sourced from local producers and suppliers with environmental impact certification. All timber will be FSC (or equivalent) certified.
Energy	Besides the energy efficiency measures relating to regulated energy, which are described in the energy statement, there will be additional energy saving measures implemented in the development:
	- Energy efficient white goods will be used
	- Low energy external lighting
WASTE	Adequate internal and external storage of recycled and non- recycled waste will be ensured. The external storage will be sized according to the frequency of collection, based on guidance from the recycling scheme operator.
	Construction waste will be minimised by implementing a site waste management plan containing procedures to minimise and divert waste from landfill.

Section 2.0

MECHANICAL SERVICES

2.1 INCOMING UTILITY SERVICES

New gas and water utility supplies/meters will be provided to the building. The gas meter will be external to the building in a ventilated space and the water meter externally in an underground pit. (Soil conditions will confirm the water pipe material).

These will be sized to meet the demands of the building.

An additional kW/hr gas sub-meter will be provided with a remote visual display installed to assist in energy monitoring and management as part of the BMS/ audio visual system.

An additional water flow meter (I/s) will be provided with a remote visual display installed to assist in water monitoring and management as part of the BMS/ audio visual system.

2.2 DESIGN CONDITIONS

External temperatures:

Winter	-8°C saturated
Summer	32°C (DB) 20°C (WB)

Internal Temperatures:

Living Rooms	21°C
Kitchen/Dining	21°C
Bedrooms	19°C
Bathrooms	23°C
Pool hall	30°C
Hall/Circulation	19°C
Stores/Plant	16°C

2.3 BUILDING REGULATIONS PART L1A (2013/16)

The current part 'L1A' of the Building Regulations (2013/16), consists of minimum requirements for dwellings, briefly consisting of the following:

- Walls, roofs and ceilings need to have adequate resistance to loss of heat.
- Sufficient control needs to be provided for occupants to vary lighting levels, to avoid unnecessary energy use and maximise natural daylight.
- Adequate user control should be available for heating and cooling to avoid unnecessary energy use and maximise passive measures.

Part 'L1A' of the Building Regulations (April 2013/16), is also concerned with the conservation of fuel and power and its aim is to maximum the possible contribution that can be made to the Government's target for reducing CO₂ production whilst allowing flexibility for designers. This philosophy will be followed in our designs.

The measures to be implemented/ investigated to reduce energy consumption are:

- Specifying an efficient heating system and if gas boilers utilised, these are to be high efficiency condensing boilers with very low NOX levels. This also includes low NOX levels for CHP units.
- Optimising the boiler selection for the building occupancy and reducing energy consumption through controls and management.
- Installing responsive controls and sub-zoning of the building to allow the part load, low energy and economical use of the system. (Adaptive to user occupancy).
- Review of thermal insulation techniques, limits and air tightness.
- Review of renewable energy sources to comply with the limits dictated by The Local Planning Authority and The Adopted London Plan.
- Minimising the effect of solar gain in a passive manner, to provide comfort conditions.

- Limiting fan power usage to noted requirements.
- Reviewing extract fan systems and utilising heat recovery and passive natural ventilation where possible.
- If cooling is utilised, to provide through a very efficient system and utilised only at peak times.

2.4 HEATING

The main space heating system will be led by a high efficiency GSHP vertical borehole system with water source heat pumps (Mitsubishi CRHV), with a COP of 5.08 complete with buffer vessel and thermal check meter. With backup/ top up from condensing boilers with ultra low NOX levels (eg Broag Remeha Quinta ACE). 90% of the heating load will be produced by the GSHP system.

The GSHP/ boilers system will serve LTHW pressurised supplies to the majority of underfloor heating systems in the principal living and bedroom areas (High thermal mass concrete floors). Radiators to secondary areas and towel rails to bathrooms will be served via a separate summer circuit. LTHW supplies will also provide the heat for the HWS system and the pool AHU/ water systems.

All internal pipework to be copper insulated and pex to underfloor systems.

All flues to discharge above main roof level by balanced flues/separate flues. Fresh air and plantroom cooling via louvers at ground floor level.

All heating zones/spaces will be provided with zone valves, re-heaters, thermostat control or TRV's (Thermostatic radiator valves), to ensure efficient energy use.

All heating zones/spaces will also be controlled by user interface controls to programme occupancy, holiday periods and set back times; again to ensure efficient energy use.

Future heating network pipework connections and plate heat exchanger space to be included within the scheme.

2.5 WATER SERVICES

A fully pressurised water system will be provided throughout the property to ensure continuity of supply. If after testing a mains water pressure system is acceptable; this will be adopted. The system is to be installed in copper pipework to the sanitary/kitchen appliances.

The general pressure available throughout the system will be approximately 3 bar at the mixers/taps with flow rates accommodated to the sanitary appliances and shower mixer valves in accordance with the Part 'G' calculator; low flow/restrictors.

The system will operate on a variable speed pump principle to maintain a constant pressure throughout the system and limit energy use. Pressure regulating devices will be required to some areas. All sanitary fittings/plant will be individually and zone valved. All pipework to be copper insulated.

Consideration will be given to a leak detection system to provide early warning of any leaks in the systems, to minimise any water loss.

2.5.1 Domestic Cold Water

Sufficient cold water will be stored and boosted to provide continuity of supply. Filtered mains drinking water will be provided to the main kitchens and the basins within each principle en-suite bathroom.

A water softener will be provided within the main basement plantroom providing softened water to the hot water cylinders, as well as all the baths and shower accommodation. (Softened water will ensure optimum energy performance due to limiting scale build up in plant/pipework).

2.5.2 DOMESTIC HOT WATER

Hot water cylinders located in the basement plantroom will be provided with boosted and conditioned cold water. The hot water cylinders will be complete with a pumped return system. The system will be heated by the boiler system.

Hot water production shall be strictly controlled by weather compensation, timeclock control for occupancy holiday times and maximisation of plant duty. (Conditioned water will ensure optimum performance due to limiting scale build up in plant/pipework).

All basins, baths and sinks will be protected by TMV2/3 valves (Thermostatic mixing valves), above the minimum Part 'G' requirements.

2.6. RECYCLED RAINWATER

The rainwater recycling drainage system will provide recycled rain water for irrigation supplies. This will reduce the reliance on treated mains water.

Filters shall be provided to the system.

2.7 NATURAL VENTILATION

Background habitable room passive ventilation is generally to be provided by trickle vents incorporated into windows or walls to the building above ground level. The LGF will be provided with an MVHR system.

Rapid ventilation to spaces will be provided by openable windows/ continuous ventilation.

Consideration will be given to a PSV (Passive stack ventilation), system to bathrooms (wet areas), with humidity controlled trickle vents to habitable spaces.

2.8 FRESH AIR SYSTEMS

Habitable rooms located within the LGF area with no windows will be provided with fresh air by mechanical ventilation heat recovery units with highly efficient counter flow heat exchangers. Mechanical ventilation system will be fully compliant with Part 'F' of the Building Regulations. Ductwork to be pre-insulated PVC and galvanised steel with insulation or Kool duct.

The swimming pool hall will have an AHU with heat recovery/ humidity control ventilation (By others).

2.9 BATHROOMS, CLOAKROOMS, STORE AND KITCHEN VENTILATION

Mechanical Extract Ventilation (MEV or intermittent) units will be provided for the purposes of sanitary accommodation, kitchen and utility ventilation. These dedicated fan systems shall comprise of isolated (low noise) ducted fan units located either within plant areas and discharge to the main roof areas or via external walls. Ductwork to be pre-insulated PVC and galvanised steel with insulation.

2.10 COMFORT COOLING

Firstly, the building has been designed to limit heat gains by; orientation, thermal mass, ventilation provision, tree shading, semi underground spaces and overhanging slabs/ roofs.

Cooling may also be considered to certain rooms/spaces.

This is proposed to be via a high efficiency GSHP system (5.84 EER), with water heat pumps located in the basement plantroom.

The type of cooling for each room will be provided by fancoils mounted either within joinery or false wall/ceiling details.

Pre-insulated discharge ductwork will be attached to these units to discharge through high induction linear grilles incorporated within joinery and wall finishes at high level. The system will have very low noise levels, which is generally to be targeted at NR25 throughout the building.

A refrigerant gas sensor system will be incorporated to provide safety/protection in accordance with FGAS requirements, to all bedrooms and other rooms/spaces. Internal pipework to be copper insulated, externally PE pipework.

Each room/space will have individual control via a remote room controller to each fan coil, controlled via a discrete room sensor for operation or modification to the set point of the controllers. Cooling and heating will be automatically controlled to ensure no system fighting and undue energy use (interlocked). Overall occupancy and holiday controls to also be provided to ensure efficient energy use and management.

2.11 AUTOMATIC CONTROLS

Automatic control systems will be provided for all of the mechanical services. It is anticipated this will be installed as a complete BMS/ DDC electronic system supervised by a touch screen control/PC positioned within the basement plantroom.

The client will also have the facility for zoned overrun of various systems and time switch control separate to the main plantroom, via a PC interlink situated within the study.

Full remote off site access will also be provided via a modem to this system enabling an ongoing maintenance contract to be provided with the system installers and for the occupiers to efficiently control the systems.

The system will have remote interface modules which will allow the client operation of the heating and cooling, lighting and other systems via the audio visual keypads. Where this is not provided, individual room control will be provided with more basic visual/manual controls.

Controls are to be zoned to provide more efficiency, occupancy control and management.

2.12 ABOVE GROUND DRAINAGE

The above ground drainage system shall be provided to serve all the sanitaryware accommodation.

It is anticipated that in the house cast iron/HDPE silent pipework will be provided, fully insulated for both thermal and acoustic reasons, with individual local run-outs to the sanitary accommodation being in Upvc pipework. Installation of leak detection systems will be considered to detect leaking water hidden in areas such as voids and shower trays etc. This is being considered to protect the building fabric and internal fixtures and fittings.

2.13 RAINWATER DRAINAGE

All rainwater pipes will be routed from roof level to drain points at ground/lower ground floor levels. All roof outlets will be sized to take a rainfall intensity of 108 mm per hour. All pipes shall have access before connecting to underground drains. All external rainwater stacks are to be either aluminium or cast iron and where installed internally, the stacks/drains shall be thermally/ acoustically insulated.

2.14 UNDERGROUND DRAINAGE

By others.

Section 3.0

ELECTRICAL SERVICES

3.1 INCOMING UTILITY SUPPLY

A new main incoming TP&N supply connection will be provided to serve the property which will be sized to suit the anticipated maximum building load.

The energy usage at the incoming position will be measured and inter-linked to the AV system providing the end-user with accurate power consumption data displayed on a visual display screen. This facility will provide the owner with a user-friendly interface for energy monitoring and management within the house. The PV system electrical load is envisaged to be utilised on site, however G99 export details TBA with UKPN. A PV generation meter and a GSHP thermal meter will be installed.

3.2 SUB-MAIN DISTRIBUTION

Sub-main distribution boards will be installed to serve various areas within the building. This will reduce cable material costs and installation time. Sub metering to Part L will be provided. The local sub-distribution boards will incorporate suitably rated MCBs and RCBOs to suit the circuit

type and loading.

Separate dedicated feeds will be supplied to life safety systems, such as fire alarm equipment in suitable fire rated cabling.

Sub-main distribution cabling will be multi-core armoured with XLPE outer sheath and LSF inner sheath with copper conductors.

Adequate spare capacity will be provided within the distribution network for any future expansion of the system, avoiding the need for any significant re-modification works at a later period.

3.3 FINAL CIRCUIT DISTRIBUTION

Final circuit distribution cabling will be multi-core flat twin & earth XLPE/LSF sheathed copper conductors and will not be of the PVC/PVC type.

The XLPE (cross-linked polyethylene) cable material offers superior electrical performance to PVC and the LSF insulation produces 'low smoke and fumes' when exposed to fire.

RCBOs will be used which combine Residual Current and Overcurrent protection within a single device. Consequently each circuit will be individually RCD protected avoiding any nuisance tripping of unaffected circuits as would be the case if a split load distribution arrangement were adopted whereby many circuits are protected by a single RCD.

3.4 SMALL POWER INSTALLATIONS

Single and twin 13A Switched Socket outlets will be provided at various positions within the property for general purpose use and to serve fixed electrical equipment.

The outlets will be positioned to offer the greatest flexibility for different interior space planning options and will be mounted at a suitable height for ease of access conforming to the Building Regulation Part M requirements.

Where the room/spaces are used as 'home offices' (e.g. where computers, printers etc. are installed causing potential earth leakage currents) then socket outlets will be of the Dual Earth connection type. 13A switched/un-switched fused connection units with neon lamps will be installed to serve various fixed items of electrical equipment.

All small power faceplate outlets will be sourced from a reputable manufacturer such as 'MK Electric' incorporating the required electrical safety standards and allowing ease of installation.

3.5 INTERIOR LIGHTING INSTALLATIONS

The lighting scheme will utilise the latest low energy compact fluorescent and long life LED/CFL lighting technologies in order to achieve a minimum of 100% low energy lighting throughout the property, exceeding the requirement as stipulated in the Building Regulations Part L.

Dimming control will be provided to the majority of the lighting systems in the form of pre-set scene setting controlled from individual wall plates in each room/space and via a wireless/ hardwired visual display screen as part of the AV control system.

Consideration is also being given to allow energy usage from the lighting system to be monitored via the AV system.

In room/spaces with sufficient natural lighting, day-linked control of the artificial lighting is also being evaluated. Computational daylight investigation will be carried to principle living areas to ascertain the benefit of day-linked dimming controls.

Room/spaces which are not lit by natural daylight, in particular escape routes and the LGF/ basement areas will incorporate emergency standby lighting with up to 3hr battery back-up. Consideration for additional emergency lighting to all escape routes will be taken.

Special attention will be made to bathrooms and the pool area lighting scheme, ensuring the correct level of Ingress Protection (IP) rating is provided in accordance with the 'zoning' requirements of the IEE Regulations.

3.6 EXTERIOR LIGHTING INSTALLATIONS

The external lighting installation will comprise of a combination of low energy compact fluorescent and LED lighting. (Light outputs will not exceed Regulations).

Luminaires will be mounted inground and away from the building for night time perimeter security lighting and will be of the wall-wash type to avoid direct light pollution into the neighbouring community.

Ground recessed and low level ground mounted garden amenity lighting will also be provided which will be limited in numbers to avoid excessive lighting and light pollution to the night sky. All external lighting will be daylight-linked via an adjustable external photocell and only switch on during periods of insufficient daylight. Manually adjustable time-clock control will also be provided to allow the occupier to adjust the time period and to switch off the lighting when not required.

3.7 AUDIO VISUAL SYSTEMS

The Audio Visual installation will generally include the following systems:

- Lighting control and management via user-friendly wireless/hardwired touch screen visual display panels located throughout building to occupiers requirement.
- Building energy monitoring via touch screen panels with scope for split monitoring of various loads e.g. lighting & power.
- Heating, comfort cooling and ventilation control via touch screen panels.
- Terrestrial and Satellite TV installation and control. For signal reception each TV will receive a single CAT 5e/6 cable input allowing multi-service viewing. Conventional coax cabling will not be installed saving on material and installation cost.
- Hardwired broadband and telephone service in CAT 5e/6 cabling.
- CCTV security monitoring around the vicinity of the building in CAT 5e/6 cabling with digital recording facility.
- Security, audio and visual access control systems to main building entrances.

3.8 SECURITY SYSTEM

A wired intruder alarm system will be provided comprising suitable room/space movement detectors, magnetic contacts to perimeter doors and window/door break glass detection. The system will be linked to a 24hr central monitoring station via a dedicated BT Redcare line and GSM. The design and installation will conform to ACPO policy and DD243 requirements for police response service.

3.9 FIRE DETECTION AND ALARM SYSTEM

The building may come under the requirements of BS5839 Part 6. The final installation design will be agreed with the relevant parties, including the Local Fire Office (Fire Brigade) and Local Council District Surveyor.

To provide the highest degree of life and property protection a 'Type L1' category system may be employed and be appropriately zoned, allowing the local fire brigade to promptly identify the location/source of fire occurrence.

The system will have the appropriate level of standby battery back-up to operate under mains power failure.

All cabling will be fire rated to the appropriate required standard.

Generally smoke detectors, incorporating base sounder units will be installed throughout the premises except within the kitchen area, plant spaces and gallery – these will be heat detectors; to avoid nuisance alarm conditions. The plant room/kitchen areas will also have carbon monoxide (CO) detectors installed.

Consideration will be given to an 'lon' based (Air sampling - Vesda), detection system in some principal areas including for CO detection.

3.10 EARTHING & BONDING

All extraneous conductive parts will be bonded to the main building earth terminal with main equipotential and supplementary earth bonds as required.

Supplementary earth bonding will be provided to areas of increased electric shock risk including bathrooms, shower rooms, swimming pool area and plant rooms.

A separate additional earth electrode system will be provided for earth bonding of the swimming pool areas as required by the IEE Regulations.

3.11 LIGHTNING PROTECTION

A lightning protection system will be installed to prevent damage to the building structure and mitigate; injury to people, physical damage (e.g. fire, explosion) and failure of internal electrical systems. The system will be designed to intercept the lightning strike and safely discharge the high voltage current to earth via a network of lightning rods and metal conductors or the building frame, connected to an earth electrode designed to provide a low resistance path to earth.

To protect sensitive electronic equipment within the property from damage and failure resulting from transient over voltages (surges), caused by lightning strikes; a suitable surge arrester will be installed at the main supply intake and on data/phone lines and for sensitive equipment.

3.12 ELECTRICAL APPLIANCES & MECHANICAL SYSTEM EQUIPMENT

Most 'white goods', including the refrigerator/freezer, cooker, microwave oven, washing machine/dryer and dishwasher will be 'A' rated (or higher) energy efficient items under the EU energy label classification.

Other major electrical plant, including condenser units and water booster pumps sets will be selected where available and or practicable to incorporate energy efficient motors and intelligent energy saving controls.

Section 4.0

M&E SUSTAINABILITY ITEMS

4.1 DAYLIGHTING

The proposed house has high levels of natural daylighting due to the glazing areas.

All main habitable rooms (Living rooms, kitchen and study), will achieve the minimum daylight factors and view of the sky.

4.2 RECYCLABLE MATERIALS

Each product/material for the M&E services shall be evaluated against Environmental impacts and life cycle costing. The following is a typical list of proposed M&E materials/products that will be utilised;

- Water pipework
- Copper (Recvclable).

Valves

.

- Brass (Recyclable).

- Phenolic foam – (Recyclable)

- PVC twin & earth (XLPE/LSF) (Recyclable) Electrical cables
- Pipework insulation •
- Rock wool (Recyclable)
- Pipework Insulation •
 - Concrete Portland cement based (Recyclable)
- Light fittings LED's/compact fluorescent (Recyclable)

4.3 SALVAGE/REUSE OF EXISTING MATERIALS

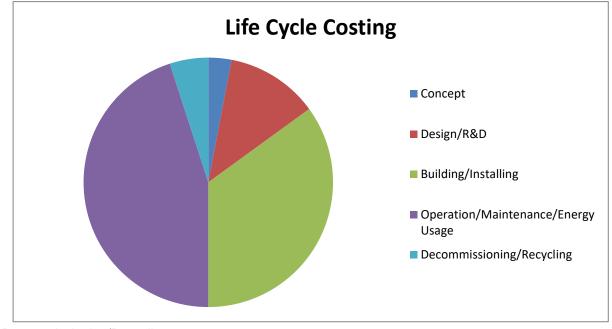
Each existing material/product will be evaluated for possible salvage/reuse when existing items/materials are removed for the proposed works.

Reuse will have priority over salvage; an economic, viability and safety assessment will be made for each item/material.

4.4 LIFE CYCLE COSTING

Each product/material proposed shall be evaluated on a life cycle costing basis. Recyclable materials shall be utilised where possible in preference to non-Recyclable.

The particular areas of the life cycle to be addressed for M&E Services are: Building & Installing the system/product, Operation/Maintenance, Energy Usage and finally,



Decommissioning/Recycling.

Below is a graph indicating the lift cycle phases;

Typically the majority of the life of a material/product is spent in the Operation/Maintenance phase. It is in this phase that it creates the value contribution but also absorbs the vast proportion of the costs through maintenance and energy usage.

Products/materials shall be selected on the basis of particularly reducing the impact of this phase, for example, a pump, by selecting long term reliability and low energy usage over initial cost.

The ease and speed of building/installing different products/systems shall also be compared to reduce this phase.

4.5 NOISE & VIBRATION

Noise and vibration associated with moving mechanical services plant, e.g. Pumps, fans, condensers, pipes/ducts, lifts and boilers shall be limited to acceptable levels as follows;

- Pumps: Inverter drives providing slow low impact start/stop cycles, intelligent controls, anti-vibration couplings/supports, dense block wall constructed plantrooms.
- Fans: Low speed intermittent ventilation fans, flexible duct connections, remote plantroom/cupboard mounting, attenuators and anti-vibration fixings.

Boilers/ GSHP: Low noise units and internally mounted within plant areas.

Pipes: Anti-vibration/flexible couplings to plant, expansion joints/anchors and smooth bends/straight lines.

Ducts: Inline attenuators, anti-vibration/flexible couplings to plant, and smooth bends/straight lines.

An Acoustic Consultant shall further advise on noise, vibration and acoustic items.

4.6 SOLAR GAINS

In compliance with the new Part 'L' of the Building Regulations (April 2013/16 edition) solar gains shall be reduced by the building being designed to limit heat gains by; orientation, thermal mass, provision of green roofs, tree shading, semi underground spaces, overhanging slabs/roofs and higher performance double glazed windows with solar tinting/low emissivity coating and Argon gas filled cavities to the South, East & West Elevations.

Additionally, internal blinds to the South, East & West Elevations may be provided as part of the development for occupiers to assist in compliance with Solar Gains.

Section 5.0

DISCLAIMER

This non-assignable report has been prepared solely for the client as a pre-planning report for the proposed development. The contents and views expressed in this report remain the copyright and opinion of ME7 Ltd. The client is to check and verify the contents with no admission of liability, duty of care or warranty to any Third Party.

This report is based on the information provided/available at the time of production.

ME7 February 2021

APPENDIX (i)

SAP L1A 2013/16 REGULATIONS

(DER Worksheet)

				User [Details:					
Assessor Name:	Ondrej Gaj	dos			Strom	a Num	ber:	STRO	0006629	
Software Name:	Stroma FS		2		Softwa	re Ve	rsion:	Versi	on: 1.0.5.7	
			P	roperty	Address:	28, Ave	enue Road			
Address :	28, Avenue	Road, L	ONDON	I, NW8	6BU					
1. Overall dwelling dime	ensions:									
2				Are	a(m²)		Av. Heigl		Volume(m	_
Basement					789.3	(1a) x	3.3	(2a) =	2604.69	(3a)
Ground floor					617	(1b) x	5.5	(2b) =	3393.5	(3b)
First floor					570.3	(1c) x	4.2	(2c) =	2395.26	(3c)
Second floor					549	(1d) x	3.1	(2d) =	1701.9	(3d)
Total floor area TFA = (1	la)+(1b)+(1c)+((1d)+(1e)+(1r	1) 2	2525.6	(4)				
Dwelling volume				-		(3a)+(3b)+(3c)+(3d)+(3e)+(3n) =	10095.35	(5)
2. Ventilation rate:					1114				and an	
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Number of chimneys	0	+	0	+	0] = [0	x 40 =	0	(6a)
Number of open flues	0	+ [0] + [4] = [4	x 20 =	80	(6b)
Number of intermittent fa	ans					Ē	16	x 10 =	160	(7a)
Number of passive vents	5					Ē	0	x 10 =	0	(7b)
Number of flueless gas f	fires					Ē	0	x 40 =	0	(7c)
						10		Airc	hanges per h	our
Infiltration due to chimne	evs. flues and fr	ans = (6a	a)+(6b)+(7	a)+(7b)+	(7c) =	Г	240	+ (5) =	0.02	(8)
If a pressurisation test has l						ontinue fr		sitest	0.02	
Number of storeys in t	the dwelling (na	5)							0	(9)
Additional infiltration								[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0	0.25 for steel or	timber f	rame or	0.35 fc	r masonr	y constr	uction		0	(11)
if both types of wall are p deducting areas of open			oonding to	the grea	ter wall are	a (after				
If suspended wooden			ed) or 0	1 (seal	ed), else	enter O			0	(12)
If no draught lobby, er	nter 0.05, else e	enter O							0	(13)
Percentage of window	s and doors dr	aught str	ripped						0	(14)
Window infiltration					0.25 - [0.2	x (14) ÷ 1	00] =		0	(15)
Infiltration rate					(8) + (10)	+ (11) + (1	12) + (13) + (1	15) =	0	(16)
Air permeability value,	, q50, expresse	ed in cub	ic metre	s per h	our per se	quare m	etre of env	elope area	4	(17)
If based on air permeabi	ility value, then	(18) = [(17	7) + 20]+(8), otherw	vise (18) = (16)			0.22	(18)
Air permeability value appli	es if a pressurisatio	on test has	been dor	e or a de	gree air per	meability	is being used	1		111
Number of sides shelter	ed								0	(19)
Shelter factor					(20) = 1 -]	1.1	[9]] =		1	(20)
Infiltration rate incorpora	ting shelter fac	tor			(21) = (18)	x (20) =			0.22	(21)
Infiltration rate modified	for monthly win	d speed		10					-	
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov Dec		

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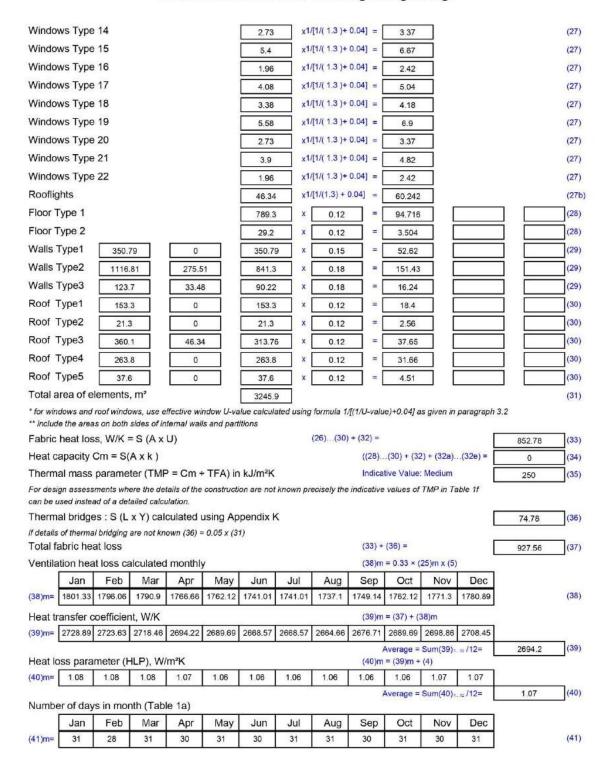
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24b)m= c) If v if 24c)m= d) If v if 24d)m=	0 whole h f (22b)r 0 natural f (22b)r 0.54	0 nouse ex n < 0.5 > 0 ventilation n = 1, th 0.54	0 tract ver (23b), t 0 on or wh en (24d) 0.54	0 htilation (24 0 ole hous m = (22 0.53	0 or positiv c) = (23 0 se positiv b)m othe 0.53	0 ve input 0); othen 0 ve input erwise (2 0.52	ventilatio wise (24 ventilatio 24d)m = 0.52	0 on from (c) = (22) 0 on from 0.5 + [(2 0.52	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 .5 × (23t 0 0.5]	0)) 0	0		(24c
24b)m= c) If v if 24c)m= d) If v if 24d)m= Effec 25)m=	0 whole h f (22b)r 0 natural f (22b)r 0.54 tive air 0.54	0 nouse ex n < 0.5 > 0 ventilation n = 1, th 0.54 change 0.54	0 tract ver (23b), t 0 on or wh en (24d) 0.54 rate - er	0 tilation (24 0 ole hous m = (22 0.53 nter (24a 0.53	0 or positiv c) = (23 0 se positi b)m othe 0.53 a) or (24 0.53	0 ve input 0); other 0 ve input erwise (2 0.52 b) or (24	ventilatio wise (24 0 ventilatio 24d)m = 0.52 c) or (24	0 on from (c) = (22) 0 on from 0.5 + [(2 0.52 0.52 (d) in box	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 .5 × (23b 0 0.5] 0.53	0) 0 0.53	0		(24c
24b)m= c) If v if 24c)m= d) If v if 24d)m= Effec 25)m=	0 whole h f (22b)r 0 natural f (22b)r 0.54 ctive air 0.54 at losse	0 nouse ex n < 0.5 > 0 ventilation n = 1, th 0.54 change 0.54	0 tract ver (23b), 1 0 on or wh en (24d) 0.54 rate - er 0.54 eat loss ss	0 ntilation (hen (24 0 ole hous m = (22 0.53 nter (24a 0.53 oaramet Openir	0 or positiv c) = (231 0 se positi b)m othe 0.53 a) or (241 0.53 er:	0 ve input 0); other 0 ve input erwise (2 0.52 b) or (24	0 ventilatio wise (24 0 ventilatio 24d)m = 0.52 c) or (24 0.52 rea	0 on from (c) = (22) 0 on from 0.5 + [(2 0.52 0.52 (d) in box	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 .5 × (23b 0 0.5] 0.53	0 0) 0.53 0.53	0	12	(24c

Doors 6.28 x 1.3 = 8.164 (26)Windows Type 1 4.79 $x1/[1/(1.3) + 0.04]$ 5.92 (27)Windows Type 2 13.04 $x1/[1/(1.3) + 0.04]$ 16.11 (27)Windows Type 3 16.83 $x1/[1/(1.3) + 0.04]$ 20.8 (27)Windows Type 4 7.19 $x1/[1/(1.3) + 0.04]$ 8.88 (27)Windows Type 5 3.38 $x1/[1/(1.3) + 0.04]$ 8.88 (27)Windows Type 6 2.73 $x1/[1/(1.3) + 0.04]$ 3.37 (27)Windows Type 7 1.96 $x1/[1/(1.3) + 0.04]$ 2.42 (27)Windows Type 8 5.58 $x1/[1/(1.3) + 0.04]$ 6.9 (27)Windows Type 9 3.38 $x1/[1/(1.3) + 0.04]$ 4.18 (27)Windows Type 10 2.73 $x1/[1/(1.3) + 0.04]$ 3.37 (27)Windows Type 11 1.96 $x1/[1/(1.3) + 0.04]$ 3.37 (27)Windows Type 12 11.16 $x1/[1/(1.3) + 0.04]$ 2.42 (27)	ELEMENT	area (m²)	m²	A ,m ²	W/m2K	(W/K)	kJ/m ² ·K	kJ/K
Windows Type 2 13.04 $x1/[1/(1.3)+0.04] =$ 16.11 (27)Windows Type 3 16.83 $x1/[1/(1.3)+0.04] =$ 20.8 (27)Windows Type 4 7.19 $x1/[1/(1.3)+0.04] =$ 8.88 (27)Windows Type 5 3.38 $x1/[1/(1.3)+0.04] =$ 8.88 (27)Windows Type 6 2.73 $x1/[1/(1.3)+0.04] =$ 3.37 (27)Windows Type 7 1.96 $x1/[1/(1.3)+0.04] =$ 2.42 (27)Windows Type 8 5.58 $x1/[1/(1.3)+0.04] =$ 6.9 (27)Windows Type 9 3.38 $x1/[1/(1.3)+0.04] =$ 4.18 (27)Windows Type 10 2.73 $x1/[1/(1.3)+0.04] =$ 3.37 (27)Windows Type 11 1.96 $x1/[1/(1.3)+0.04] =$ 3.37 (27)Windows Type 12 11.16 $x1/[1/(1.3)+0.04] =$ 2.42 (27)	Doors			6.28	x 1.3 =	8.164		(26)
Windows Type 316.83 $x1/[1/(1.3)+0.04] =$ 20.8(27)Windows Type 47.19 $x1/[1/(1.3)+0.04] =$ 8.88(27)Windows Type 53.38 $x1/[1/(1.3)+0.04] =$ 4.18(27)Windows Type 62.73 $x1/[1/(1.3)+0.04] =$ 3.37(27)Windows Type 71.96 $x1/[1/(1.3)+0.04] =$ 2.42(27)Windows Type 8 5.58 $x1/[1/(1.3)+0.04] =$ 6.9(27)Windows Type 9 3.38 $x1/[1/(1.3)+0.04] =$ 4.18(27)Windows Type 10 2.73 $x1/[1/(1.3)+0.04] =$ 3.37(27)Windows Type 11 1.96 $x1/[1/(1.3)+0.04] =$ 3.37(27)Windows Type 12 11.16 $x1/[1/(1.3)+0.04] =$ 2.42(27)	Windows Type	1		4.79	x1/[1/(1.3)+0.04] =	5.92		(27)
Windows Type 4 7.19 $x1/[1/(1.3)+0.04] =$ 8.88 (27)Windows Type 5 3.38 $x1/[1/(1.3)+0.04] =$ 4.18 (27)Windows Type 6 2.73 $x1/[1/(1.3)+0.04] =$ 3.37 (27)Windows Type 7 1.96 $x1/[1/(1.3)+0.04] =$ 2.42 (27)Windows Type 8 5.58 $x1/[1/(1.3)+0.04] =$ 6.9 (27)Windows Type 9 3.38 $x1/[1/(1.3)+0.04] =$ 6.9 (27)Windows Type 10 2.73 $x1/[1/(1.3)+0.04] =$ 3.37 (27)Windows Type 11 1.96 $x1/[1/(1.3)+0.04] =$ 3.37 (27)Windows Type 12 11.16 $x1/[1/(1.3)+0.04] =$ 2.42 (27)	Windows Type	2		13.04	x1/[1/(1.3)+ 0.04] =	16.11		(27)
Windows Type 5 3.38 $x1/[1/(1.3)+0.04] =$ 4.18 (27)Windows Type 6 2.73 $x1/[1/(1.3)+0.04] =$ 3.37 (27)Windows Type 7 1.96 $x1/[1/(1.3)+0.04] =$ 2.42 (27)Windows Type 8 5.58 $x1/[1/(1.3)+0.04] =$ 6.9 (27)Windows Type 9 3.38 $x1/[1/(1.3)+0.04] =$ 4.18 (27)Windows Type 10 2.73 $x1/[1/(1.3)+0.04] =$ 3.37 (27)Windows Type 11 1.96 $x1/[1/(1.3)+0.04] =$ 2.42 (27)Windows Type 12 11.16 $x1/[1/(1.3)+0.04] =$ 13.79 (27)	Windows Type	3		16.83	x1/[1/(1.3)+0.04] =	20.8		(27)
Windows Type 6 2.73 $x1/[1/(1.3)+0.04] =$ 3.37 (27)Windows Type 7 1.96 $x1/[1/(1.3)+0.04] =$ 2.42 (27)Windows Type 8 5.58 $x1/[1/(1.3)+0.04] =$ 6.9 (27)Windows Type 9 3.38 $x1/[1/(1.3)+0.04] =$ 4.18 (27)Windows Type 10 2.73 $x1/[1/(1.3)+0.04] =$ 3.37 (27)Windows Type 11 1.96 $x1/[1/(1.3)+0.04] =$ 2.42 (27)Windows Type 12 11.16 $x1/[1/(1.3)+0.04] =$ (27)	Windows Type	4		7,19	x1/[1/(1.3)+ 0.04] =	8.88		(27)
Windows Type 7 1.96 $x1/[1/(1.3)+0.04] =$ 2.42 (27)Windows Type 8 5.58 $x1/[1/(1.3)+0.04] =$ 6.9 (27)Windows Type 9 3.38 $x1/[1/(1.3)+0.04] =$ 4.18 (27)Windows Type 10 2.73 $x1/[1/(1.3)+0.04] =$ 3.37 (27)Windows Type 11 1.96 $x1/[1/(1.3)+0.04] =$ 2.42 (27)Windows Type 12 11.16 $x1/[1/(1.3)+0.04] =$ 13.79 (27)	Windows Type	5		3.38	x1/[1/(1.3)+0.04] =	4.18		(27)
Windows Type 8 5.58 $x1/[1/(1.3)+0.04] =$ 6.9 (27)Windows Type 9 3.38 $x1/[1/(1.3)+0.04] =$ 4.18 (27)Windows Type 10 2.73 $x1/[1/(1.3)+0.04] =$ 3.37 (27)Windows Type 11 1.96 $x1/[1/(1.3)+0.04] =$ 2.42 (27)Windows Type 12 11.16 $x1/[1/(1.3)+0.04] =$ 13.79 (27)	Windows Type	6		2.73	x1/[1/(1.3)+ 0.04] =	3.37		(27)
Windows Type 9 3.38 $x1/[1/(1.3) + 0.04] =$ 4.18 (27)Windows Type 10 2.73 $x1/[1/(1.3) + 0.04] =$ 3.37 (27)Windows Type 11 1.96 $x1/[1/(1.3) + 0.04] =$ 2.42 (27)Windows Type 12 11.16 $x1/[1/(1.3) + 0.04] =$ 13.79 (27)	Windows Type	7		1.96	x1/[1/(1.3)+ 0.04] =	2.42		(27)
Windows Type 10 2.73 $x1/[1/(1.3) + 0.04] =$ 3.37 (27)Windows Type 11 1.96 $x1/[1/(1.3) + 0.04] =$ 2.42 (27)Windows Type 12 11.16 $x1/[1/(1.3) + 0.04] =$ 13.79 (27)	Windows Type	8		5.58	x1/[1/(1.3)+ 0.04] =	6.9		(27)
Windows Type 11 1.96 $x1/[1/(1.3) + 0.04] =$ 2.42 (27) Windows Type 12 11.16 $x1/[1/(1.3) + 0.04] =$ 13.79 (27)	Windows Type	9		3.38	x1/[1/(1.3)+ 0.04] =	4.18		(27)
Windows Type 12 11.16 $x^{1/[1/(1.3)+0.04]} = 13.79$ (27)	Windows Type	10		2.73	x1/[1/(1.3)+ 0.04] =	3.37		(27)
	Windows Type	11		1.96	$x^{1/[1/(1.3)+0.04]} =$	2.42		(27)
	Windows Type	12		11.16	x1/[1/(1.3)+ 0.04] =	13.79		(27)
$5.58 \qquad \text{xi}_1/(1.3) + 0.04] = 6.9 \qquad (27)$	Windows Type	13		5.58	x1/[1/(1.3)+ 0.04] =	6.9		(27)

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4. Water hea	ating ene	rgy requ	irement:								kWh/yea	ir:	
Assumed occ if TFA > 13 if TFA £ 13	.9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.(0013 x (TFA -13		03		(42)
Annual avera Reduce the annu	ial average	hot water	usage by	5% if the a	welling is	designed t			se target o		7.3		(43)
ot more that 12	o intres per	person per	r day (all w	ater use, r	not and co	(a)							
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
lot water usage	in litres per	day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)		_				
14)m= 195.03	187.94	180.84	173.75	166.66	159.57	159.57	166.66	173.75	180.84	187.94	195.03		
Energy content o	of hot water	used - cal	culated m	onthly = 4.	190 x Vd,r	n x nm x E)Tm / 3600			m(44)1 - 12 = ables 1b, 1		2127.58	(44)
45)m= 289.22	252.96	261.03	227.57	218.36	188.43	174.61	200.36	202.75	236.29	257.93	280.1		
									Total = Su	m(45)112	-	2789.6	(45)
f instantaneous	water heati	ng at point	of use (no	hot water	r storage),	enter 0 in	boxes (46) to (61)					_
46)m= 43.38	37.94	39.15	34.14	32.75	28.26	26.19	30.05	30.41	35.44	38.69	42.01		(46)
Vater storage	e loss:												
Storage volur	ne (litres) includir	ng any se	olar or W	WHRS	storage	within sa	ame ves	sel		2000		(47)
f community	heating a	and no ta	nk in dw	velling, e	nter 110	litres in	(47)						
Otherwise if r	no stored	hot wate	er (this ir	icludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in ((47)			
Vater storage	e loss:									-			
a) If manufac	cturer's d	eclared I	oss facto	or is kno	wn (kWł	n/day):				6.	.67		(48
emperature	factor fro	m Table	2b							0.	54		(49
nergy lost fr	om water	storage	, kWh/ye	ear			(48) x (49) =		3	.6		(50
b) If manufac	cturer's d	eclared o	cylinder	oss fact	or is not	known:							
lot water sto	1. 1. A. C.			e 2 (kW	h/litre/da	iy)					0		(51
f community			on 4.3										
olume factor										<u> </u>	0		(52
emperature	factor fro	m Table	20								0		(53)
nergy lost fr			, kWh/ye	ear			(47) x (51) x (52) x (53) =		0		(54
Enter (50) or	(54) in (55)								3	.6		(55
Vater storage	e loss cal	culated f	for each	month			((56)m = (55) × (41)	m				
56)m= 111.66	100.85	111.66	108.05	111.66	108.05	111.66	111.66	108.05	111.66	108.05	111.66		(56)
cylinder contain	ns 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 Appendix	н	
57)m= 111.66	100.85	111.66	108.05	111.66	108.05	111.66	111.66	108.05	111.66	108.05	111.66		(57)
									10000				/69
Primary circui					E0)m =	EQ1 : 20	E . (44)	-			0		(58)
rimary circui (modified b									r thormo	(total)			
		02200200	1.00000000	0502500002	0.0000000000	02000.0494	-		23.26	1	22.26		(59
59)m= 23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.20	22.51	23.26		(55
Combi loss ca	alculated	for each	month	(61)m =	(60) ÷ 36	65 × (41)m						
61)m= 0	0	0	0	0	0	0	0	0	0	0	0		(61)
otal heat rec	quired for	water he	eating ca	alculated	for eac	h month	(62)m =	0.85 ×	(45)m +	(46)m +	(57)m + (5	59)m + (61)r	n
62)m= 424.14	374.82	395.95	358.14	353.28	318.99	309.52	335.28	333.32	371.21	388.5	415.01		(62
iolar DHW input	calculated	using App	endix G or	Appendix	H (negati	ve quantit	/) (enter '0	' if no sola	r contribut	tion to wate	er heating)		
add additiona													
	1				r		i .	ŕ		1			(63)
63)m= 0	0	0	0	0	0	0	0	0	0	0	0		(05

	424.14	374.82	395.95	358.14	353.28	318.99	309.52	335.28	333.32	371.21	388.5	415.01		
								Out	out from wa	ater heate	r (annual)	9	4378.15	(64)
leat ga	ains froi	n water	heating,	kWh/m	onth 0.2	5 ' [0.85	× (45)m	n + (61)n	n] + 0.8 x	(46)m	+ (57)m	+ (59)m]]	
65) m=	204.1	181.6	194.73	180.12	180.54	167.1	165.99	174.55	171.87	186.5	190.21	201.07		(65)
inclu	de (57)	m in calo	culation (of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	ater is fi	om com	munity he	eating	
5. Int	ernal ga	ins (see	e Table 5	i and 5a):	2								
/letabo	olic gain	s (Table	e 5), Wat	ts										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
66)m=	301.26	301.26	301.26	301.26	301.26	301.26	301.26	301.26	301.26	301.26	301.26	301.26		(66
ighting	g gains	(calcula	ted in Ar	pendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5					
37)m=	162.57	144.39	117.43	88.9	66.45	56.1	60.62	78.8	105.76	134.29	156.74	167.09		(67
nopliar	nces gai	ns (calc	ulated in	Append	lix L. ea	uation L	13 or L1	3a), also	see Tal	ole 5				
			1676.19		•				1300.95	0.0020.0201	1515.43	1627.91		(68
Cookin	L gains	(calcula	ted in A	nnendix	l equal	ion I 15	or L15a)) also si	ee Table	5				
59)m=	53.13	53.13	53.13	53.13	53.13	53.13	53.13	53.13	53.13	53.13	53.13	53.13		(69
L	10.040	Constantion .	(Table 5	1.25	00005				100000					
70)m=	6	6 6	6	6	6	6	6	6	6	6	6	6		(70
- C - L		anoratio												1.3
r	-241.01	-241.01	on (nega -241.01	-241.01	-241.01	-241.01	-241.01	-241.01	-241.01	-241.01	-241.01	-241.01		(71
	Supervised States	ai vai	Sector Cont	-241.01	-241.01	-241.01	-241.01	-241.01	-241.01	-241.01	-241.01	-241.01		N.C.
72)m=		gains (T 270.23	261.73	250.17	242.66	232.09	223.11	234.62	238.71	250.67	264.19	270.25		(72
2 jiii-	214.55	210.23	201.75	230.17	242.00	202.09	220.11	204.02	230.(1		204.18			112
		1000 B (1000 100				100		1 (00)	(00)	701- 1/7	41- 1 (70)			
T	<u> </u>	gains =		0000.00	4000.0	history.	San Carte	55-675	Real and the		1)m + (72)			(73)
73)m= [2259.33	2254.73		2039.83	1890.2	(66 1756.8)m + (67)m 1677.19	n + (68)m 1689.21	+ (69)m + (1764.8	70)m + (7 1900.1	1)m + (72) 2055.73	m 2184.63		(73
73)m= 6. Sol	2259.33 Iar gains	2254.73	2174.73			1756.8	1677.19	1689.21	1764.8	1900.1	2055.73	2184.63		(73
73)m= 6. Sol Solar ga	2259.33 lar gains ains are c	2254.73	2174.73 using sola	r flux from	Table 6a :	1756.8 and assoc	1677.19 iated equa	1689.21	1764.8	1900.1	2055.73	2184.63	Gains	(73
73)m= 6. Sol Solar ga	2259.33 ar gains ains are c ation: A	2254.73	2174.73 using sola actor		Table 6a :	1756.8 and assoc Flu	1677.19 iated equa	1689.21	1764.8	1900.1 e applical	2055.73	2184.63	Gains (W)	(73
73)m= 6. Sol Solar ga Drienta	2259.33 ar gains ains are c ation: A T	2254.73 alculated Access F able 6d	2174.73 using sola Factor	r flux from Area m²	Table 6a :	1756.8 and assoc Flu Ta	1677.19 iated equa IX ble 6a	1689.21 ations to co	1764.8 onvert to th g_ able 6b	1900.1 e applical T	2055.73 ble orientat FF able 6c	2184.63	(W)	_
73)m= [6. Solar ga Solar ga Drienta	2259.33 lar gains ains are c ation: A T 0.9x	2254.73 alculated Access F able 6d	2174.73 using sola Factor	r flux from Area m ²	Table 6a a	1756.8 and assoc Flu Ta	1677.19 iated equa IX ble 6a 10.63	1689.21 ations to co	1764.8 onvert to th g_ able 6b 0.63	1900.1 e applicat T	2055.73 ble orientat FF able 6c 0.7	2184.63	(W) 72.53	(74
73)m= 6. Sola Solar g Orienta Iorth	2259.33 ar gains ains are c ation: A 0.9x 0.9x	2254.73 alculated Access F able 6d 0.77 0.77	2174.73 using sola actor	r flux from Area m ²	Table 6a : 16	1756.8 and assoc Flu Ta x 1 x 1	1677.19 iated equa IX ble 6a 10.63	1689.21 ations to co T X	1764.8 onvert to th g_ able 6b 0.63 0.63	1900.1 e applicat T X	2055.73 ble orientat FF able 6c 0.7 0.7	2184.63 ion.	(W) 72.53 90.67	(74
73)m= 6. Solar gi Solar gi Drienta Iorth Iorth Iorth	2259.33 ar gains aains are c ation: <i>A</i> 0.9x 0.9x 0.9x	2254.73 alculated Access F able 6d 0.77 0.77 0.77	2174.73 using sola Factor	r flux from Area m ² 111. 5.5	Table 6a a	1756.8 and assoc Flu Ta x 1 x 1 x	1677.19 iated equa IX ble 6a 10.63 10.63	1689.21 ations to co	1764.8 onvert to th <u>9_</u> Table 6b 0.63 0.63 0.63	1900.1 e applicat X [X [X [X [2055.73 ple orientat FF able 6c 0.7 0.7 0.7	2184.63	(W) 72.53 90.67 53.23	(74 (74 (74
73)m= 6. Solar gi Solar gi Drienta Drienta Iorth Iorth Iorth Iorth	2259.33 ar gains ation: <i>A</i> ation: <i>A</i> 0.9x 0.9x 0.9x 0.9x	2254.73 alculated Access F able 6d 0.77 0.77 0.77	2174.73 using sola Factor	r flux from Area m ² 11. 5.5 2.7 5.	Table 6a : 16 ;8 '3	1756.8 and assoc Flu Ta x 1 x 1 x 1 x 1	1677.19 iated equa IX ble 6a 10.63 10.63 10.63	1689.21 ations to cc X	1764.8 onvert to th <u>9</u> able 6b 0.63 0.63 0.63 0.63	1900.1 e applicat X [X [X [X [X [2055.73 ble orientat FF able 6c 0.7 0.7 0.7 0.7	2184.63 ion. = [] = [] = [(W) 72.53 90.67 53.23 17.55	(74 (74 (74
73)m= 6. Solar g Drienta Iorth Iorth Iorth Iorth	2259.33 ar gains ains are c ation: A 0.9x [0.9x [0.9x [0.9x] 0.9x [2254.73 alculated access F able 6d 0.77 0.77 0.77 0.77	2174.73 using sola Factor	r flux from Area m ² 111. 5.5 2.7 5.	Table 6a : 16 :8 :3 4 :6	1756.8 and assoc Flu Ta x 1 x 1 x 1 x 1 x 1	1677.19 iated equa IX ble 6a 10.63 10.63 10.63 10.63	1689.21 ations to co X X X X X X X X X X X X X X X X X X X	1764.8 onvert to th able 6b 0.63 0.63 0.63 0.63 0.63	1900.1 e applicat X [X [X [X [2055.73 De orientat FF able 6c 0.7 0.7 0.7 0.7 0.7 0.7	2184.63 ion. = [] = [] = [] = [(W) 72.53 90.67 53.23 17.55 25.48	(74 (74 (74 (74
73)m= 6. Solar g: Solar g: Drienta Iorth Iorth Iorth Iorth Iorth Iorth	2259.33 ar gains ains are c ation: A 0.9x [0.9x [0.9x] 0.9x [0.9x] 0.9x [2254.73 alculated Access F able 6d 0.77 0.77 0.77	2174.73 using sola Factor	r flux from Area m ² 11. 5.5 2.7 5.	Table 6a : 16 :8 :3 4 :6	1756.8 and assoc Flu Ta x 1 x 1 x 1 x 1 x 1	1677.19 iated equa IX ble 6a 10.63 10.63 10.63	1689.21 ations to cc X	1764.8 onvert to th <u>9</u> able 6b 0.63 0.63 0.63 0.63	1900.1 e applicat X [X [X [X [X [2055.73 ble orientat FF able 6c 0.7 0.7 0.7 0.7	2184.63 ion. = [] = [] = [(W) 72.53 90.67 53.23 17.55	(74
73)m= 6. Sol Solar ga	2259.33 ar gains ains are c ation: A 0.9x [0.9x [0.9x [0.9x] 0.9x [2254.73 alculated access F able 6d 0.77 0.77 0.77 0.77	2174.73 using sola actor x x x x x	r flux from Area m ² 111. 5.5 2.7 5.	Table 6a : 16 :8 '3 4 16 18	1756.8 and assoc Flu X 1 X 1 X 1 X 1 X 1 X 1	1677.19 iated equa IX ble 6a 10.63 10.63 10.63 10.63	1689.21 ations to co X X X X X X X X X X X X X X	1764.8 onvert to th able 6b 0.63 0.63 0.63 0.63 0.63	1900.1 e applicat X [X [X [X [X [X [X [2055.73 De orientat FF able 6c 0.7 0.7 0.7 0.7 0.7 0.7	2184.63 ion. = [] = [] = [] = [(W) 72.53 90.67 53.23 17.55 25.48	(74 (74 (74 (74

Orienta	ation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b	Т	FF able 6c		Gains (W)	
North	0.9x	0.77	x	11.16	× [10.63] × [0.63] × [0.7	=	72.53	(74)
North	0.9x	0.77	x	5.58	x	10.63] × [0.63) × [0.7] = [90.67	(74)
North	0.9x	0.77	×	2.73	x	10.63] × [0.63] × [0.7] = [53.23	(74)
North	0.9x	0.77	×	5.4	x	10.63) × [0.63) × [0.7	= [17.55	(74)
North	0.9x	0.77	x	1.96	×	10.63] × [0.63] × [0.7	=	25.48	(74)
North	0.9x	0.77	x	4.08	×	10.63) × [0.63) × [0.7] = [13.26	(74)
North	0.9x	0.77	x	11.16	×	20.32	×	0.63] × [0.7	=	138.61	(74)
North	0.9x	0.77	x	5.58	×	20.32] × [0.63] × [0.7] = [173.27	(74)
North	0.9x	0.77	x	2.73	×	20.32] × [0.63] × [0.7	=	101.73	(74)
North	0.9x	0.77	×	5.4	X [20.32] × [0.63] × [0.7] = [33.54	(74)
North	0.9x	0.77	×	1.96	×	20.32] × [0.63] × [0.7	=	48.69	(74)
North	0.9x	0.77	×	4.08	×	20.32] × [0.63) × [0.7] = [25.34	(74)

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North	0.9x	0.77	x	11.16	x	34.53	x	0.63] × [0.7	7 = [235.54	(74)
North	0.9x	0.77	T x	5.58	ī × Ē	34.53	ī × Ē	0.63	ī × Ē	0.7	ĭ - ┣	294.43	(74)
North	0.9x	0.77	×	2.73	╡ <u>×</u> ┌	34.53	i × F	0.63	i × F	0.7	i = F	172.86	(74)
North	0.9x	0.77	×	5.4	x	34.53	ī × [0.63	ī × [0.7	i - F	56.99	(74)
North	0.9x	0.77	×	1.96		34.53	ī × [0.63	ī × Ē	0.7	Π - Γ	82.73	(74)
North	0.9x	0.77	×	4.08	T × T	34.53	ī × [0.63	ī × Ē	0.7	<u> </u> = [43.06	(74)
North	0.9x	0.77	×	11.16	T × T	55.46	ī × Ē	0.63	ī × Ē	0.7	-	378.34	(74)
North	0.9x	0.77	x	5.58	T × T	55.46	ī × [0.63	Ī×Ē	0.7	ī - Ē	472.92	(74)
North	0.9x	0.77	×	2.73	X	55.46] × [0.63] × [0.7	<u>]</u> = [277.65	(74)
North	0.9x	0.77	x	5.4	×	55.46] × [0.63] × [0.7] = [91.53	(74)
North	0.9x	0.77	×	1.96	×	55.46	×	0.63] × [0.7] = [132.89	(74)
North	0.9x	0.77	×	4.08	×	55.46] × [0.63	×	0.7	=	69.16	(74)
North	0.9x	0.77	x	11.16	x	74.72	×	0.63	×	0.7	=	509.66	(74)
North	0.9x	0.77	x	5.58	x	74.72	×	0.63	×	0.7	=	637.07	(74)
North	0.9x	0.77	x	2.73	×	74.72) × [0.63) x [0.7	=	374.02	(74)
North	0.9x	0.77	x	5.4	×	74.72	×	0.63	×	0.7] 🗧 [123.3	(74)
North	0.9x	0.77	×	1.96	×	74.72) × [0.63] × [0.7] = [179.02	(74)
North	0.9x	0.77	x	4.08	x	74.72	×	0.63	×	0.7] = [93.16	(74)
North	0.9x	0.77	X	11.16	×	79.99	×	0.63	×	0.7	=	545.6	(74)
North	0.9x	0.77	x	5.58	x	79.99	_ × [0.63) × [0.7	=	682	(74)
North	0.9x	0.77	x	2.73	×	79.99	×	0.63	×	0.7	=	400.4	(74)
North	0.9x	0.77	×	5.4	×	79.99	× [0.63] × [0.7] = [132	(74)
North	0.9x	0.77	x	1.96	x	79.99	×	0.63	×	0.7	=	191.65	(74)
North	0.9x	0.77	x	4.08	×	79.99	×	0.63	×	0.7	=	99.73	(74)
North	0.9x	0.77	x	11.16	x	74.68	×	0.63	×	0.7	=	509.39	(74)
North	0.9x	0.77	x	5.58	×	74.68	×	0.63	×	0.7	=	636.74	(74)
North	0.9x	0.77	x	2.73	×	74.68	_ × [0.63	_ × [0.7	=	373.83	(74)
North	0.9x	0.77	x	5.4	x	74.68	×	0.63	x	0.7	=	123.24	(74)
North	0.9x	0.77	×	1.96	×	74.68	×	0.63	×	0.7	=	178.93	(74)
North	0.9x	0.77	x	4.08	×	74.68	_ × [0.63	_ × [0.7	_ = [93.11	(74)
North	0.9x	0.77	x	11.16	×	59.25	×	0.63	_ × [0.7	=	404.14	(74)
North	0.9x	0.77	x	5.58	x	59.25	×	0.63	×	0.7	=	505.17	(74)
North	0_9x	0.77	x	2.73	×	59.25	×	0.63	×	0.7	=	296.58	(74)
North	0.9x	0.77	×	5.4	×	59.25	×	0.63	×	0.7	=	97.77	(74)
North	0.9x	0.77	×	1.96	×	59.25	×	0.63	×	0.7	=	141.95	(74)
North	0.9x	0.77	x	4.08	x	59.25	× [0.63	×	0.7	=	73.87	(74)
North	0.9x	0.77	x	11.16	_ × [41.52	_ × [0.63	_ × [0.7	=	283.2	(74)
North	0.9x	0.77	×	5.58	×	41.52	× [0.63	×	0.7	_ = _	354	(74)
North	0.9x	0.77	×	2.73	×	41.52	_ × [0.63	× [0.7	_ = [207.83	(74)
North	0.9x	0.77	×	5.4	×	41.52	_ × [0.63	_ × [0.7	_ = _	68.52	(74)
North	0.9x	0.77	×	1.96	x	41.52	×	0.63	×	0.7	=	99.47	(74)

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North	0.9x	0.77	x	4.08	x	41.52	x	0.63	×	0.7	=	51.77	(74)
North	0.9x	0.77	×	11.16	ī × [24.19	ī × [0.63	٦×٢	0.7	٦ - F	165	(74)
North	0.9x	0.77	X	5.58	ī × ī	24.19	ī × [0.63	Ī×Ē	0.7] = [206.25	(74)
North	0.9x	0.77	x	2.73	x	24.19	Ī x [0.63] × [0.7	-	121.09	(74)
North	0.9x	0.77	×	5.4	×	24.19] × [0.63	X	0.7] = [39.92	(74)
North	0.9x	0.77	×	1.96	×	24.19	×	0.63	×	0.7] = [57.96	(74)
North	0.9x	0.77	×	4.08	×	24.19] × [0.63	×	0.7] = [30.16	(74)
North	0.9x	0.77	x	11.16	×	13.12	x	0.63) × [0.7] = [89.48	(74)
North	0.9x	0.77	x	5.58	x	13.12	×	0.63	×	0.7	= [111.85	(74)
North	0.9x	0.77	x	2.73	×	13.12) × [0.63	_ × [0.7] = [65.67	(74)
North	0.9x	0.77	x	5.4	×	13.12	×	0.63	×	0.7	=	21.65	(74)
North	0.9x	0.77	×	1.96	×	13.12	×	0.63	×	0.7	=	31.43	(74)
North	0.9x	0.77	x	4.08	x	13.12	×	0.63	×	0.7	=	16.36	(74)
North	0.9x	0.77	х	11.16	×	8.86	x	0.63	x	0.7	=	60.47	(74)
North	0.9x	0.77	x	5.58	×	8.86	× [0.63	×	0.7	=	75.58	(74)
North	0.9x	0.77	x	2.73	×	8.86	_ × [0.63	×	0.7		44.38	(74)
North	0.9x	0.77	×	5.4	×	8.86	× [0.63	× [0.7	_ = _	14.63	(74)
North	0.9x	0.77	x	1.96	x	8.86	x	0.63	×	0.7	=	21.24	(74)
North	0.9x	0.77	x	4.08	×	8.86	× [0.63	×	0.7	_ = [11.05	(74)
East	0.9x	0.54	x	4.79	x	19.64	_ × [0.63	×	0.7	=	20.16	(76)
East	0.9x	0.54	x	13.04	×	19.64	×	0.63	×	0.7	=	54.89	(76)
East	0.9x	0.54	×	16.83	×	19.64	×	0.63	× [0.7	_ = [70.84	(76)
East	0.9x	0.54	x	7.19	x	19.64	×	0.63	×	0.7		30.27	(76)
East	0.9x	0.77	x	3.38	×	19.64	×	0.63	×	0.7	=	20.29	(76)
East	0.9x	0.77	x	5.58	x	19.64	×	0.63	×	0.7	=	200.96	(76)
East	0.9x	0.77	x	2.73	×	19.64	×	0.63	×	0.7	=	81.93	(76)
East	0.9x	0.77	x	3.9	x	19.64	×	0.63	×	0.7	=	46.82	(76)
East	0.9x	0.77	x	1.96	x	19.64	x	0.63	×	0.7	=	35.29	(76)
East	0.9x	0.54	×	4.79	×	38.42	×	0.63	×	0.7	=	39.44	(76)
East	0.9x	0.54	x	13.04	×	38.42	×	0.63	×	0.7		107.38	(76)
East	0.9x	0.54	x	16.83	×	38.42	×	0.63	×	0.7	=	138.59	(76)
East	0.9x	0.54	x	7.19	×	38.42	×	0.63	×	0.7	=	59.21	(76)
East	0.9x	0.77	x	3.38	x	38.42	×	0.63	×	0.7	_ = _	39.69	(76)
East	0.9x	0.77	×	5.58	×	38.42	×	0.63	×	0.7		393.12	(76)
East	0.9x	0.77	×	2.73	×	38.42	×	0.63	×	0.7		160.28	(76)
East	0.9x	0.77	x	3.9	×	38.42	×	0.63	×	0.7		91.59	(76)
East	0.9x	0.77	x	1.96	×	38.42	×	0.63	×	0.7	_ = _	69.04	(76)
East	0.9x	0.54	×	4.79	×	63.27	_ × _	0.63	×	0.7	_ = _	64.96	(76)
East	0.9x	0.54	×	13.04	×	63.27	×	0.63	×	0.7	_ = _	176.84	(76)
East	0.9x	0.54	×	16.83	×	63.27	×	0.63	×	0.7		228.23	(76)
East	0.9x	0.54	x	7.19	x	63.27	×	0.63	×	0.7	=	97.5	(76)

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East	0.9x	0.77	×	3.38	X	63.27	×	0.63	×	0.7	=	65.36	(76)
East	0.9x	0.77] × [5.58	x	63.27	×	0.63	×	0.7	<u>]</u> = [647.41	(76)
East	0.9x	0.77] × [2.73] × [63.27] × [0.63] × [0.7] = [263.95	(76)
East	0.9x	0.77	×	3.9	x	63.27	×	0.63	×	0.7] = [150.83	(76)
East	0.9x	0.77	×	1.96	x	63.27	×	0.63	×	0.7] = [113.7	(76)
East	0.9x	0.54	×	4.79	×	92.28	×	0.63	×	0.7] = [94.74	(76)
East	0.9x	0.54	×	13.04	×	92.28) × [0.63	_ × [0.7	=	257.91	(76)
East	0.9x	0.54	x	16.83	×	92.28	x	0.63	X [0.7] = [332.86	(76)
East	0.9x	0.54	×	7.19) x [92.28	×	0.63	×	0.7] = [142.2	(76)
East	0.9x	0.77	x	3.38	x	92.28	×	0.63	×	0.7] = [95.32	(76)
East	0.9x	0.77	×	5.58	×	92.28	×	0.63	×	0.7] = [944.2	(76)
East	0.9x	0.77	×	2.73	_ × [92.28	_ × [0.63	×	0.7] = [384.96	(76)
East	0.9x	0.77	×	3.9	x	92.28	×	0.63	×	0.7] = [219.98	(76)
East	0.9x	0.77	x	1.96	x	92.28	×	0.63	×	0.7] = [165.83	(76)
East	0.9x	0.54	x	4.79	×	113.09	X [0.63	x	0.7	=	116.1	(76)
East	0.9x	0.54	x	13.04	×	113.09) × [0.63	×	0.7] = [316.07	(76)
East	0.9x	0.54	× [16.83	× [113.09] × [0.63	_ × [0.7] = [407.94	(76)
East	0.9x	0.54	x	7.19	x	113.09	x	0.63	×	0.7] = [174.28	(76)
East	0.9x	0.77	x	3.38	×	113.09	×	0.63	×	0.7	=	116.82	(76)
East	0.9x	0.77	x	5.58	×	113.09	_ × [0.63	×	0.7	=	1157.16	(76)
East	0.9x	0.77	×	2.73	×	113.09	x	0.63	× [0.7] = [471.78	(76)
East	0.9x	0.77	×	3.9	×	113.09	× [0.63	_ × [0.7] = [269.59	(76)
East	0.9x	0.77	×	1_96	x	113.09	×	0.63	×	0.7] = [203.23	(76)
East	0.9x	0.54	×	4.79	×	115.77	×	0.63	×	0.7	=	118.85	(76)
East	0.9x	0.54	x	13.04	x	115.77	_ × [0.63	_ × [0.7	=	323.56	(76)
East	0.9x	0.54	x	16.83	×	115.77	×	0.63	×	0.7	=	417.6	(76)
East	0.9x	0.54	×	7.19	x	115.77	×	0.63	×	0.7	=	178.4	(76)
East	0.9x	0.77	x	3.38	x	115.77	x	0.63	x	0.7	=	119.59	(76)
East	0.9x	0.77	×	5.58	×	115.77	×	0.63	×	0.7	=	1184.56	(76)
East	0.9x	0.77	x	2.73	x	115.77	×	0.63	×	0.7	=	482.95	(76)
East	0.9x	0.77	x	3.9	×	115.77	×	0.63	×	0.7	=	275.97	(76)
East	0.9x	0.77	x	1.96	x	115.77	x	0.63	x	0.7	=	208.04	(76)
East	0.9x	0.54	x	4.79	x	110.22	×	0.63	×	0.7] = [113.15	(76)
East	0.9x	0.54	×	13.04	_ × [110.22	× [0.63	× [0.7	_ = [308.04	(76)
East	0.9x	0.54	×	16.83	×	110.22	×	0.63	×	0.7	_ = [397.57	(76)
East	0.9x	0.54	x	7.19	x	110.22	, x.	0.63	×	0.7] = [169.85	(76)
East	0.9x	0.77	x	3.38	×	110.22	×	0.63	×	0.7	=	113.85	(76)
East	0.9x	0.77	×	5.58	x	110.22	×	0.63	×	0.7	=	1127.74	(76)
East	0.9x	0.77	×	2.73	×	110.22] × [0.63	_ × [0.7] = [459.79	(76)
East	0.9x	0.77	×	3.9	×	110.22	×	0.63	×	0.7	=	262.74	(76)
East	0.9x	0.77	x	1.96	x	110.22	×	0.63	×	0.7	=	198.06	(76)

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East	0.9x	0.54	×	4.79	x	94.68	×	0.63	×	0.7	=	97.2	(76)
East	0.9x	0.54	x	13.04	×	94.68	×	0.63	×	0.7] = [264.6	(76)
East	0.9x	0.54	x	16.83) × [94.68] × [0.63) × [0.7	=	341.51	(76)
East	0.9x	0.54	×	7.19	x	94.68	×	0.63	×	0.7] = [145.9	(76)
East	0.9x	0.77	×	3.38	×	94.68) × [0.63] × [0.7] = [97.8	(76)
East	0.9x	0.77	×	5.58	x	94.68	x	0.63	×	0.7] = [968.72	(76)
East	0.9x	0.77	×	2.73	×	94.68) × [0.63	×	0.7] = [394.95	(76)
East	0.9x	0.77	x	3.9	×	94.68	x	0.63	×	0.7] = [225.69	(76)
East	0.9x	0.77	×	1.96	_ x [94.68	×	0.63	×	0.7] = [170.13	(76)
East	0.9x	0.54	x	4.79	×	73.59	×	0.63	×	0.7] = [75.55	(76)
East	0.9x	0.54	×	13.04	x	73.59	×	0.63	×	0.7	=	205.67	(76)
East	0.9x	0.54	x	16.83	×	73.59	×	0.63	×	0.7	=	265.44	(76)
East	0.9x	0.54	x	7.19	x	73.59	×	0.63	×	0.7	=	113.4	(76)
East	0.9x	0.77	x	3.38	x	73.59	×	0.63	×	0.7	=	76.02	(76)
East	0.9x	0.77	x	5.58	×	73.59	× [0.63	_ x [0.7	=	752.96	(76)
East	0.9x	0.77	×	2.73	x	73.59	×	0.63	×	0.7		306.99	(76)
East	0.9x	0.77	×	3.9	× [73.59) × [0.63	_ × [0.7] = [175.42	(76)
East	0.9x	0.77	x	1.96	x	73.59	x	0.63	×	0.7	= [132.24	(76)
East	0.9x	0.54	X	4.79	×	45.59	×	0.63	×	0.7	=	46.8	(76)
East	0.9x	0.54	x	13.04	_ × [45.59	×	0.63	_ × [0.7	=	127.41	(76)
East	0.9x	0.54	×	16.83	×	45.59) × [0.63	× [0.7] = [164.45	(76)
East	0.9x	0.54	_ × [7.19	×	45.59	× [0.63	_ × [0.7] = [70.25	(76)
East	0.9x	0.77	x	3.38	x	45.59	×	0.63	×	0.7	_ = [47.09	(76)
East	0.9x	0.77	×	5.58	×	45.59	×	0.63	×	0.7	=	466.47	(76)
East	0.9x	0.77	x	2.73	x	45.59	_ × [0.63	×	0.7	=	190.18	(76)
East	0.9x	0.77	x	3.9	×	45.59	×	0.63	×	0.7	=	108.67	(76)
East	0.9x	0.77	x	1.96	x	45.59	×	0.63	×	0.7	=	81.92	(76)
East	0.9x	0.54	x	4.79	x	24.49	×	0.63	×	0.7	= [25.14	(76)
East	0.9x	0.54	×	13.04	×	24.49	×	0.63	×	0.7	=	68.44	(76)
East	0.9x	0.54	x	16.83	x	24.49	×	0.63	×	0.7	=	88.33	(76)
East	0.9x	0.54	x	7.19	x	24.49	×	0.63	×	0.7	=	37.74	(76)
East	0.9x	0.77	x	3.38	x	24.49	×	0.63	x	0.7	=	25.3	(76)
East	0.9x	0.77	x	5.58	x	24.49	×	0.63	x	0.7	=	250.57	(76)
East	0.9x	0.77	×	2.73	×	24.49	×	0.63	× [0.7	=	102.16	(76)
East	0.9x	0.77	×	3.9	×	24.49	×	0.63	×	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.96	x	24.49	x	0.63	×	0.7] = [44.01	(76)
East	0.9x	0.54	x	4.79	x	16.15	_ × [0.63	x	0.7	=	16.58	(76)
East	0.9x	0.54	x	13.04	x	16.15	x	0.63	×	0.7	= [45.14	(76)
East	0.9x	0.54	_ × [16.83	×	16.15] × [0.63] × [0.7] = [58.26	(76)
East	0.9x	0.54	_ × [7.19	×	16.15	_ × [0.63	×	0.7] = [24.89	(76)
East	0.9x	0.77	x	3.38	x	16.15		0.63	×	0.7	-	16.68	(76)

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East	0.9x (0.77	x	5.58	x	16.15	x	0.63	x	0.7] = [165.26	(76)
East		0.77	x	2.73	x	16.15	i x i	0.63	×	0.7	i - i	67.38	(76)
East	0.9x (0.77	x	3.9	x	16.15	i × i	0.63	x	0.7	i = i	38.5	(76)
East	0.9x (0.77	×	1.96	x	16.15	i x i	0.63	x	0.7	i - i	29.02	(76)
South	0.9x (0.77	x	3.38	x	46.75] × [0.63	×	0.7	ī - ī	386.35	(78)
South	0.9x (0.77	x	2.73	x	46.75] × [0.63	x	0.7	ī - ī	351.06	(78)
South	0.9x 0	0.77	×	1.96	×	46.75	ī × i	0.63	×	0.7	ī - ī	140.02	(78)
South	0.9x (0.77	x	3.38	x	76.57	x	0.63	×	0.7] = [632.74	(78)
South	0.9x (0.77	x	2.73	x	76.57	×	0.63	×	0.7] = [574.94	(78)
South	0.9x (0.77	x	1.96	x	76.57	x	0.63	×	0.7] = [229.32	(78)
South	0.9x (0.77	x	3.38	x	97.53	×	0.63	×	0.7] = [806	(78)
South	0.9x (0.77	×	2.73	×	97.53	×	0.63	×	0.7	=	732.37	(78)
South	0.9x (0.77	×	1.96	x	97.53	×	0.63	×	0.7] = [292.11	(78)
South	0.9x (0.77	x	3.38	x	110.23	x	0.63	x	0.7] = [910.95	(78)
South	0.9x (0.77	x	2.73	x	110.23	×	0.63	x	0.7	=	827.74	(78)
South	0.9x (0.77	x	1.96	x	110.23	×	0.63	×	0.7] = [330.15	(78)
South	0.9x (0.77	×	3.38	×	114.87	×	0.63	×	0.7] = [949.27	(78)
South	0.9x (0.77	x	2.73	x	114.87	x	0.63	x	0.7] = [862.56	(78)
South	0.9x (0.77	x	1.96	x	114.87	×	0.63	×	0.7] = [344.04	(78)
South	0.9x (0.77	x	3.38	x	110.55	×	0.63	x	0.7	=	913.54	(78)
South	0.9x (0.77	x	2.73	x	110.55	×	0.63	×	0.7	=	830.09	(78)
South	0.9x (0.77	×	1.96	×	110.55	(X)	0.63	×	0.7	=	331.09	(78)
South	0.9x (0.77	x	3.38	x	108.01	(x)	0.63	x	0.7	=	892.59	(78)
South	0.9x (0.77	x	2.73	×	108.01	×	0.63	×	0.7	=	811.05	(78)
South	0.9x (0.77	x	1.96	x	108.01	×	0.63	x	0.7	=	323.5	(78)
South	0.9x (0.77	х	3.38	x	104.89	×	0.63	×	0.7	=	866.82	(78)
South	0.9x (0.77	x	2.73	x	104.89	×	0.63	×	0.7	=	787.64	(78)
South	0.9x (77.0	x	1.96	х	104.89	×	0.63	x	0.7	=	314.16	(78)
South	0.9x (0.77	×	3.38	×	101.89	×	0.63	×	0.7	=	841.96	(78)
South	0.9x (0.77	х	2.73	x	101.89	×	0.63	×	0.7	_ = _	765.05	(78)
South	Contras -	0.77	x	1.96	x	101.89	×	0.63	×	0.7	=	305.15	(78)
South	0.9x (0.77	x	3.38	x	82.59	×	0.63	x	0.7	_ ⁼ L	682.47	(78)
South		0.77	x	2.73	х	82.59	×	0.63	×	0.7	_ = _	620.13	(78)
South		0.77	×	1.96	×	82.59	×	0.63	×	0.7	<u> </u> = [247.34	(78)
South		0.77	×	3.38	×	55.42	×	0.63	×	0.7	╡╹╽	457.95	(78)
South		0.77	x	2.73	x	55.42	x	0.63	×	0.7	_ = L	416.12	(78)
South		0.77	x	1.96	x	55.42	×	0.63	×	0.7	_ = _	165.97	(78)
South		0.77	x	3.38	x	40.4	×	0.63	×	0.7	╡╹	333.84	(78)
South		0.77	×	2.73	×	40.4	×	0.63	×	0.7	╡╹┟	303.35	(78)
South	1000	0.77	x	1.96	×	40.4	×	0.63	×	0.7	=	120.99	(78)
West	0.9x (0.77	x	5.58	x	19.64	×	0.63	×	0.7	=	133.97	(80)

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West	0.9x	0.77	×	3.38	X	19.64	×	0.63] × [0.7] = [40.58	(80)
West	0.9x	0.77	Ξ×Γ	2.73	i × i	19.64	i × i	0.63	i × F	0.7	≓ - F	98.32	(80)
West	0.9x	0.77	Ξ×Γ	1.96	╡ <u>,</u>	19.64	i × F	0.63	i × F	0.7	╡╻┢	35.29	(80)
West	0.9x	0.77	٦×٢	5.58	x	38.42	ī × [0.63	٦×٢	0.7	⊣ - F	262.08	(80)
West	0.9x	0.77	Ξ×Γ	3.38	i × F	38.42	ī × Ē	0.63	i × r	0.7	⊣ - F	79.37	(80)
West	0.9x	0.77	٦ × Г	2.73	T x T	38.42	ī × Ī	0.63	ī × Ē	0.7	<u>i - F</u>	192.33	(80)
West	0.9x	0.77	i × i	1.96	ī × ī	38.42	ī × ī	0.63	ī × Ē	0.7	≓ - F	69.04	(80)
West	0.9x	0.77	ī × ī	5.58	ī × ī	63.27	ī × ī	0.63	ī × Ē	0.7	≓ - F	431.6	(80)
West	0.9x	0.77	آ × آ	3.38	٦ × ٦	63.27] × [0.63] × [0.7	ī = [130.72	(80)
West	0.9x	0.77	x	2.73	×	63.27] × [0.63] × [0.7	<u> </u> = [316.74	(80)
West	0.9x	0.77	x [1.96	×	63.27] × [0.63] × [0.7] = [113.7	(80)
West	0.9x	0.77	x	5.58	×	92.28] × [0.63] × [0.7	=	629.47	(80)
West	0.9x	0.77	x	3.38	×	92.28	×	0.63] × [0.7] = [190.65	(80)
West	0.9x	0.77	x	2.73	x	92.28	×	0.63	× [0.7] = [461.95	(80)
West	0.9x	0.77	x	1.96	x	92.28	× [0.63) × [0.7	=	165.83	(80)
West	0.9x	0.77	x	5.58	x	113.09) × [0.63) × [0.7] 🗧 [771.44	(80)
West	0.9x	0.77	×	3.38	×	113.09] × [0.63) × [0.7] = [233.64	(80)
West	0.9x	0.77	x	2.73	x	113.09	×	0.63	×	0.7] = [566.14	(80)
West	0.9x	0.77	x	1.96	×	113.09	×	0.63	× [0.7	=	203.23	(80)
West	0.9x	0.77	x	5.58	_ × [115.77] × [0.63] × [0.7	=	789.7	(80)
West	0.9x	0.77	x	3.38	×	115.77) × [0.63) × [0.7] = [239.18	(80)
West	0.9x	0.77	×	2.73	×	115.77	×	0.63	_ × [0.7] = [579.54	(80)
West	0.9x	0.77	x	1_96	x	115.77	×	0.63) × [0.7] = [208.04	(80)
West	0.9x	0.77	×	5.58	×	110.22	×	0.63	×	0.7	=	751.83	(80)
West	0.9x	0.77	x	3.38	x	110.22	_ × [0.63	_ × [0.7	=	227.7	(80)
West	0.9x	0.77	x	2.73	x	110.22	×	0.63	×	0.7	=	551.75	(80)
West	0.9x	0.77	x	1.96	x	110.22	×	0.63	_ × [0.7	=	198.06	(80)
West	0.9x	0.77	x	5.58	x	94.68	×	0.63	_ × [0.7	=	645.81	(80)
West	0.9x	0.77	×	3.38	×	94.68	×	0.63	×	0.7	=	195.59	(80)
West	0.9x	0.77	x	2.73	x	94.68	×	0.63	_ × [0.7	=	473.94	(80)
West	0.9x	0.77	x	1.96	×	94.68	×	0.63	×	0.7	=	170.13	(80)
West	0.9x	0.77	x	5.58	x	73.59	×	0.63	_ × [0.7	=	501.97	(80)
West	0.9x	0.77	x	3.38	x	73.59	×	0.63	×	0.7	=	152.03	(80)
West	0.9x	0.77	×	2.73	×	73.59	×	0.63	× [0.7	=	368.38	(80)
West	0.9x	0.77	×	1.96	×	73.59	×	0.63	×	0.7	=	132.24	(80)
West	0.9x	0.77	x	5.58	x	45.59	X	0.63	×	0.7	_ = [310.98	(80)
West	0.9x	0.77	x	3.38	×	45.59	_ × [0.63	_ × [0.7	=	94.18	(80)
West	0.9x	0.77	×	2.73	×	45.59	_ × [0.63	_ × [0.7	=	228.22	(80)
West	0.9x	0.77	×	1.96	×	45.59	_ × [0.63	_ × [0.7	=	81.92	(80)
West	0.9x	0.77	x	5.58	×	24.49	_ × [0.63	×	0.7] = [167.05	(80)
West	0.9x	0.77	x	3.38	x	24.49	×	0.63	×	0.7	=	50.59	(80)

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		_	r						_					
Vest 0.9x	0.77	x	2.7	3	x	24.49	×	0.63	×	0.7	=	122	.59	(80
/est 0.9x	0.77	x	1.9	6	x	24.49	×	0.63	×	0.7	=	44.	01	(80
est 0.9x	0.77	x	5.5	18	×	16.15	×	0.63	×	0.7	=	110	.17	(80
/est 0.9x	0.77	x	3.3	8	x	16.15	x	0.63	×	0.7	=	33.	37	(80
est 0.9x	0.77	x	2.7	3	x	16.15	×	0.63	×	0.7	=	80.	85	(80
est 0.9x	0.77	x	1.9	6	x	16.15	×	0.63	×	0.7	=	29	02	(80
ooflights 0.9x	1	x	46.3	34	×	26	×	0.63	×	0.7	=	47	8.2	(82
ooflights 0.9x	1	x	46.3	34	x	54	x	0.63	×	0.7	=	993	.19	(82
ooflights 0.9x	1	x	46.3	34	x	96	×	0.63	×	0.7	=	176	5.67	(82
ooflights 0.9x	1	х	46.3	34	x	150	×	0.63	×	0.7	=	275	3.85	(82
ooflights 0.9x	1	x	46.3	34	x	192	×	0.63	×	0.7	=	353	1.33	(82
ooflights 0.9x	1	x	46.3	34	×	200	×	0.63	×	0.7	=	367	3.47	(82
ooflights 0.9x	1	x	46.3	34	x	189	×	0.63	×	0.7	=	347	6.15	(82
ooflights 0.9x	1	х	46.3	34	x	157	x	0.63	×	0.7	=	288	7.6	(82
poflights 0.9x	1	x	46.3	34	x	115	× _	0.63	x [0.7	=	211	5.12	(82
ooflights 0.9x	1	x	46.3	34	x	66) × [0.63	×	0.7	-	121	3.89	(82
ooflights 0.9x	1	×	46.3	34	×	33) × [0.63	× [0.7	-	606	.95	(82
ooflights 0.9x	1	x	46.3	34	x	21	×	0.63	×	0.7	-	386	.24	(82
an state state and a second	nal tempe	rature ((heating	season)			10115.16	7302.88	5123.47	4271.52			_
Temperature	nal tempe during he	rature (ating pe	(heating eriods in	season the livi) ng area	from Ta			7302.88	5123.47	4271.52	2	1	_
Femperature	nal tempe during he	rature (ating pe	(heating eriods in	season the livi) ng area	from Ta			7302.88 Oct	5123.47	4271.52 Dec		1	(84
Temperature Utilisation fac	nal tempe during he tor for gai	ating pe	(heating eriods in iving are	season the livii ea, h1,m) ng area (see Ta	from Ta able 9a)	ble 9, Th	n1 (°C)					1	_
Femperature Jtilisation fac Jan 5)m= 1	nal tempe during he tor for gai Feb 1	eating period ins for li Mar 1	(heating eriods in iving are Apr 1	season h the livin ea, h1,m May 0.98) (see Ta Jun 0.9	from Ta able 9a) Jul 0.76	ble 9, Th Aug 0.84	n1 (°C) Sep 0.98	Oct	Nov	Dec		1	(8
Temperature Jtilisation fac Jan 5)m= 1 Mean internal	nal tempe during he tor for gai Feb 1	eating period ins for li Mar 1	(heating eriods in iving are Apr 1	season h the livin ea, h1,m May 0.98) (see Ta Jun 0.9	from Ta able 9a) Jul 0.76	ble 9, Th Aug 0.84	n1 (°C) Sep 0.98	Oct	Nov	Dec		1	(8)
Temperature Jtilisation fac Jan 6)m= 1 Mean internal 7)m= 19.8	hal tempe during he tor for gai Feb 1 temperat	inature (ating pe ins for li Mar 1 ture in l 20.1	(heating eriods in iving are Apr 1 iving are 20.38	season the livin ea, h1,m May 0.98 ea T1 (fo 20.64) (see Ta Jun 0.9)llow ste 20.84	from Tal able 9a) Jul 0.76 eps 3 to 20.92	ble 9, Th Aug 0.84 7 in Tab 20.9	n1 (°C) Sep 0.98 le 9c) 20.71	Oct 1	Nov	Dec 1		ť	(85
Temperature Jtilisation fac Jan 5)m= 1 Mean internal 7)m= 19.8 Temperature	hal tempe during he tor for gai Feb 1 temperat	inature (ating pe ins for li Mar 1 ture in l 20.1	(heating eriods in iving are Apr 1 iving are 20.38	season the livin ea, h1,m May 0.98 ea T1 (fo 20.64) (see Ta Jun 0.9)llow ste 20.84	from Tal able 9a) Jul 0.76 eps 3 to 20.92	ble 9, Th Aug 0.84 7 in Tab 20.9	n1 (°C) Sep 0.98 le 9c) 20.71	Oct 1	Nov	Dec 1		1	(85 (86 (87
Temperature Jtilisation fac Jan 6)m= 1 Mean internal 7)m= 19.8 Temperature 8)m= 20.02	hal temper during he tor for gai Feb 1 temperat 19.9 during he 20.02	rature (ating pe ins for li Mar 1 ture in l 20.1 ating pe 20.02	(heating eriods in iving are Apr 1 iving are 20.38 eriods in 20.03	season the livin ea, h1,m May 0.98 ea T1 (fo 20.64 the rest of 20.03) (see Ta Jun 0.9 bllow ste 20.84 dwelling 20.04	from Tal able 9a) Jul 0.76 eps 3 to 20.92 g from Ta 20.04	ble 9, Th Aug 0.84 7 in Tab 20.9 able 9, T 20.04	n1 (°C) Sep 0.98 le 9c) 20.71 h2 (°C)	Oct 1 20.36	Nov 1 20.03	Dec 1 19.78		1	(85 (86 (87
Temperature Jtilisation fac Jan 6)m= 1 Mean internal 7)m= 19.8 Temperature 8)m= 20.02 Jtilisation fac	hal temperators for gai	rature (ating pe ins for li Mar 1 ture in l 20.1 20.02 20.02	(healing eriods in iving are Apr 1 iving are 20.38 eriods in 20.03 est of dv	season the livin ea, h1,m May 0.98 ea T1 (fo 20.64 the rest of 20.03 welling,) ng area (see Ta Jun 0.9 Nllow ste 20.84 dwelling 20.04 h2,m (se	from Tal able 9a) Jul 0.76 eps 3 to 20.92 g from Ta 20.04 ee Table	ble 9, Th Aug 0.84 7 in Tab 20.9 able 9, T 20.04 20.04	n1 (°C) Sep 0.98 le 9c) 20.71 Th2 (°C) 20.03	Oct 1 20.36 20.03	Nov 1 20.03 20.03	Dec 1 19.78 20.02		1	(8) (8) (8) (8)
Cemperature Jtilisation fac Jan 6)m= 1 Mean internal 7)m= 19.8 Cemperature 8)m= 20.02 Jtilisation fac 9)m= 1	temperative for for gain for for gain for for gain temperative for for gain for for gain for for gain temperative for for	rature (ating points for li Mar 1 20.1 20.02 20.02 ins for m 1	(heating eriods in iving are Apr 1 iving are 20.38 eriods in 20.03 est of dv 0.99	Season the livin ea, h1,m May 0.98 ea T1 (for 20.64 n rest of 20.03 welling, 0.96) ng area (see Ta Jun 0.9 billow ste 20.84 dwelling 20.04 h2,m (se 0.84	from Tai able 9a) Jul 0.76 eps 3 to 20.92 g from Ta 20.04 ee Table 0.63	ble 9, Th Aug 0.84 7 in Tab 20.9 able 9, T 20.04 99a) 0.73	n1 (°C) Sep 0.98 le 9c) 20.71 h2 (°C) 20.03 0.97	Oct 1 20.36 20.03	Nov 1 20.03	Dec 1 19.78		1	(88) (88) (87) (88)
Temperature Utilisation fac Jan 6)m= 1 Mean internal 7)m= 19.8 Temperature 8)m= 20.02 Utilisation fac 9)m= 1 Mean internal	temperation for gain temperati	inature (ating points for li Mar 1 20.1 20.02 20.02 ins for m 1 ture in t	(heating eriods in iving are Apr 1 iving are 20.38 eriods in 20.03 est of dv 0.99 the rest of	Season the livin ea, h1,m May 0.98 ea T1 (for 20.64 n rest of 20.03 welling, 0.96 of dwelli) ng area (see Ta Jun 0.9)) llow ste 20.84 dwelling 20.04 h2,m (se 0.84 ng T2 (f	from Tai able 9a) Jul 0.76 eps 3 to 20.92 g from Ta 20.04 ee Table 0.63 follow sta	ble 9, Th Aug 0.84 7 in Tab 20.9 able 9, T 20.04 9 9a) 0.73 eps 3 to	n1 (°C) Sep 0.98 le 9c) 20.71 Th2 (°C) 20.03 0.97 7 in Tabl	Oct 1 20.36 20.03 1 le 9c)	Nov 1 20.03 20.03	Dec 1 19.76 20.02		1	(85) (86) (83) (83) (85)
Femperature Jtilisation fac Jan 6)m= 1 Mean internal 7)m= 19.8 Femperature 8)m= 20.02 Jtilisation fac 9)m= 1 Mean internal	temperative for for gain for for gain for for gain temperative for for gain for for gain for for gain temperative for for	rature (ating points for li Mar 1 20.1 20.02 20.02 ins for m 1	(heating eriods in iving are Apr 1 iving are 20.38 eriods in 20.03 est of dv 0.99	Season the livin ea, h1,m May 0.98 ea T1 (for 20.64 n rest of 20.03 welling, 0.96) ng area (see Ta Jun 0.9 billow ste 20.84 dwelling 20.04 h2,m (se 0.84	from Tai able 9a) Jul 0.76 eps 3 to 20.92 g from Ta 20.04 ee Table 0.63	ble 9, Th Aug 0.84 7 in Tab 20.9 able 9, T 20.04 99a) 0.73	n1 (°C) Sep 0.98 le 9c) 20.71 Th2 (°C) 20.03 0.97 7 in Tabl 19.71	Oct 1 20.36 20.03 1 e 9c) 19.21	Nov 1 20.03 20.03 1 18.72	Dec 1 19.78 20.02 1 18.35]]]]		(85) (86) (83) (83) (83) (83)
Temperature Jtilisation fac Jan 6)m= 1 Mean internal 7)m= 19.8 Temperature B)m= 20.02 Utilisation fac 9)m= 1 Mean internal	temperation for gain temperati	inature (ating points for li Mar 1 20.1 20.02 20.02 ins for m 1 ture in t	(heating eriods in iving are Apr 1 iving are 20.38 eriods in 20.03 est of dv 0.99 the rest of	Season the livin ea, h1,m May 0.98 ea T1 (for 20.64 n rest of 20.03 welling, 0.96 of dwelli) ng area (see Ta Jun 0.9)) llow ste 20.84 dwelling 20.04 h2,m (se 0.84 ng T2 (f	from Tai able 9a) Jul 0.76 eps 3 to 20.92 g from Ta 20.04 ee Table 0.63 follow sta	ble 9, Th Aug 0.84 7 in Tab 20.9 able 9, T 20.04 9 9a) 0.73 eps 3 to	n1 (°C) Sep 0.98 le 9c) 20.71 Th2 (°C) 20.03 0.97 7 in Tabl 19.71	Oct 1 20.36 20.03 1 e 9c) 19.21	Nov 1 20.03 20.03	Dec 1 19.78 20.02 1 18.35			(85) (86) (83) (83) (83) (83)
Temperature Jtilisation fac Jan 6)m= 1 Mean internal 7)m= 19.8 Temperature B)m= 20.02 Utilisation fac 9)m= 1 Mean internal 0)m= 18.36	temperat 18.52	rature (ating poins for li Mar 1 20.1 20.02 ms for r 1 18.81 ture in t 18.81	(heating eriods in iving are Apr 1 iving are 20.38 eriods in 20.03 est of du 0.99 the rest of 19.22 r the wh	Season the livin ea, h1,m May 0.98 ea T1 (for 20.64 n rest of 20.03 welling, 0.96 of dwelling 19.61 ole dwe) ng area (see Ta Jun 0.9)))))))))))))))))))	from Tai able 9a) Jul 0.76 eps 3 to 20.92 g from Ta 20.04 ee Table 0.63 follow ste 19.95	ble 9, Th Aug 0.84 7 in Tab 20.9 able 9, T 20.9 able 9, T 20.9 0.73 eps 3 to 19.93 + (1 - fl	11 (°C) Sep 0.98 le 9c) 20.71 Th2 (°C) 20.03 0.97 7 in Tabl 19.71 1 LA) × T2	Oct 1 20.36 20.03 1 le 9c) 19.21 fLA = Livir	Nov 1 20.03 20.03 1 18.72 ng area + (r	Dec 1 19.78 20.02 1 18.35 4) =]]]]		(80) (80) (83) (80) (90) (90)
Femperature Jtilisation fac: Jan 6)m= 1 Mean internal 7)m= 19.8 Femperature 8)m= 20.02 Jtilisation fac: 9)m= 1 Mean internal 0)m= 18.36 Mean internal 2)m= 18.43	temperat 18.52	instor li mating points for li mar 1 20.1 20.02 ins for m 1 18.81 ture in t 18.81	(heating eriods in iving are Apr 1 iving are 20.38 eriods in 20.03 est of dv 0.99 the rest of 19.22 r the who 19.28	Season the livin ea, h1,m May 0.98 ea T1 (fo 20.64 n rest of 20.03 welling, 0.96 of dwelli 19.61 ole dwe 19.66) ng area (see Ta Jun 0.9)))))))))))))))))))	from Ta able 9a) Jul 0.76 eps 3 to 20.92 g from Ta 20.04 ee Table 0.63 follow ste 19.95	ble 9, Th Aug 0.84 7 in Tab 20.9 able 9, T 20.9 able 9, T 20.04 9 a) 0.73 eps 3 to 19.93 + (1 - ft 19.98	11 (°C) Sep 0.98 le 9c) 20.71 Th2 (°C) 20.03 0.97 7 in Tabl 19.71 1 LA) × T2 19.76	Oct 1 20.36 20.03 1 19.21 fLA = Livir 19.26	Nov 1 20.03 20.03 1 18.72	Dec 1 19.78 20.02 1 18.35]]]]		(85
Temperature Jtilisation fac Jan 6)m= 1 Mean internal 7)m= 19.8 Temperature 8)m= 20.02 Jtilisation fac 9)m= 1 Mean internal 0)m= 18.36 Mean internal 2)m= 18.43 Apply adjustm	temperat 1	rature (ating points for li Mar 1 20.1 20.02 20.02 ins for m 1 18.81 ture in t 18.88 ture (for 18.88 e mean	(healing eriods in iving are Apr 1 iving are 20.38 eriods in 20.03 est of dv 0.99 the rest of 19.22 r the who 19.28 internal	season the livin ea, h1,m May 0.98 ea T1 (fc 20.64 the rest of 20.03 welling, 0.96 of dwellin 19.61 ole dwe 19.66 temper) ng area (see Ta Jun 0.9)) (low ste 20.84 dwelling 20.04 h2,m (se 0.84 ng T2 (f 19.87 lling) = f 19.92 ature fro	from Tai able 9a) Jul 0.76 eps 3 to 20.92 g from Ta 20.94 ee Table 0.63 follow ste 19.95 LA × T1 20 m Table	ble 9, Th Aug 0.84 7 in Tab 20.9 able 9, T 20.9 able 9, T 20.04 9 a) 0.73 eps 3 to 19.93 + (1 - ft 19.98 e 4e, wh	11 (°C) Sep 0.98 le 9c) 20.71 Th2 (°C) 20.03 0.97 7 in Tabl 19.71 1 LA) × T2 19.76 ere appro	Oct 1 20.36 20.03 1 19.21 fLA = Livir 19.26 opriate	Nov 1 20.03 20.03 1 18.72 ng area + (- 18.78	Dec 1 19.78 20.02 1 18.35 4) = 18.42]]]]		(85 (86 (87 (82 (82 (92 (97) (97) (97) (97)
(6)m= 1 Mean internal 19.8 (7)m= 19.8 Temperature 8)m= (8)m= 20.02 Utilisation fac: 9)m= (9)m= 1 Mean internal 10)m= (18.36) 18.36 Mean internal 12,m= (2)m= 18.43 Apply adjustm 18.43	all temperative during he temperative 1 temperative 20.02 during he 20.02 temperative 1 temperative 1 temperative 1 temperative 18.52 temperative 18.59 nent to the 18.59	rature (ating points for line of the second	(heating eriods in iving are Apr 1 iving are 20.38 eriods in 20.03 est of dv 0.99 the rest of 19.22 r the who 19.28	Season the livin ea, h1,m May 0.98 ea T1 (fo 20.64 n rest of 20.03 welling, 0.96 of dwelli 19.61 ole dwe 19.66) ng area (see Ta Jun 0.9)))))))))))))))))))	from Ta able 9a) Jul 0.76 eps 3 to 20.92 g from Ta 20.04 ee Table 0.63 follow ste 19.95	ble 9, Th Aug 0.84 7 in Tab 20.9 able 9, T 20.9 able 9, T 20.04 9 a) 0.73 eps 3 to 19.93 + (1 - ft 19.98	11 (°C) Sep 0.98 le 9c) 20.71 Th2 (°C) 20.03 0.97 7 in Tabl 19.71 1 LA) × T2 19.76	Oct 1 20.36 20.03 1 19.21 fLA = Livir 19.26	Nov 1 20.03 20.03 1 18.72 ng area + (r	Dec 1 19.78 20.02 1 18.35 4) =]]]]		(80) (80) (83) (80) (90) (90)
Temperature Jailisation fac Jan 6)m= 1 Mean internal 7)m= 19.8 Temperature 8)m= 20.02 Utilisation fac 9)m= 1 Mean internal 0)m= 18.36 Mean internal 0)m= 18.43 Apply adjustm 3)m= 18.43 8. Space heat	al tempe during he tor for gai 1 temperat 19.9 during he 20.02 tor for gai 1 temperat 18.52 temperat 18.59 tempt to the 18.59 ting required	rature (ating points for li Mar 1 20.1 20.02 ins for re 1 ture in t 18.81 ture (for 18.88 e mean 18.88 rement	(healing eriods in iving are Apr 1 iving are 20.38 eriods in 20.03 est of du 0.99 the rest of 19.22 r the who 19.28 internal 19.28	season the livin ea, h1,m May 0.98 ea T1 (fc 20.64 trest of 20.03 welling, 0.96 of dwelli 19.61 19.66 temper 19.66) ng area (see Ta Jun 0.9)) llow ste 20.84 dwelling 20.04 h2,m (se 0.84 ng T2 (f 19.87 lling) = f 19.92 ature fro 19.92	from Tai able 9a) Jul 0.76 eps 3 to 20.92 g from Tai 20.04 ee Table 0.63 follow ste 19.95 tLA × T1 20 m Table 20	ble 9, Th Aug 0.84 7 in Tab 20.9 able 9, T 20.9 able 9, T 20.04 9 9a) 0.73 eps 3 to 19.93 + (1 - ft 19.98 e 4e, wh 19.98	n1 (°C) Sep 0.98 le 9c) 20.71 h2 (°C) 20.03 0.97 7 in Tabl 19.71 19.76 ere appro-	Oct 1 20.36 20.03 1 19.21 19.21 19.26 opriate 19.26	Nov 1 20.03 20.03 1 18.72 18.78 18.78	Dec 1 19.78 20.02 1 18.35 4) = 18.42 18.42			(8) (8) (8) (8) (8) (9) (9) (9) (9)
Temperature Jtilisation fac Jan 6)m= 1 Mean internal 7)m= 19.8 Temperature 8)m= 20.02 Jtilisation fac 9)m= 1 Mean internal 0)m= 18.36 Mean internal 2)m= 18.43 Apply adjustro 3)m= 18.43 B. Space heat Set Ti to the r	all temperative during he temperative 1 temperative 19.9 during he 20.02 temperative 1 temperative 18.52 temperative 18.52 temperative 18.59 temp to the 18.59 temp require 18.59 temp require	rature (ating points for li Mar 1 20.1 20.02 ins for r 1 20.02 ins for r 1 18.81 ture in t 18.88 e mean 18.88 rement rnal ten	(healing eriods in iving are Apr 1 iving are 20.38 eriods in 20.03 est of dv 0.99 the rest of 19.22 r the wh 19.28 internal 19.28	season the livin a, h1,m May 0.98 a T1 (fc 20.64 rest of 20.03 welling, 0.96 of dwelli 19.61 temper 19.66 re obtain) ng area (see Ta Jun 0.9)) llow ste 20.84 dwelling 20.04 h2,m (se 0.84 ng T2 (f 19.87 lling) = f 19.92 ature fro 19.92	from Tai able 9a) Jul 0.76 eps 3 to 20.92 g from Tai 20.04 ee Table 0.63 follow ste 19.95 tLA × T1 20 m Table 20	ble 9, Th Aug 0.84 7 in Tab 20.9 able 9, T 20.9 able 9, T 20.04 9 9a) 0.73 eps 3 to 19.93 + (1 - ft 19.98 e 4e, wh 19.98	n1 (°C) Sep 0.98 le 9c) 20.71 h2 (°C) 20.03 0.97 7 in Tabl 19.71 19.76 ere appro-	Oct 1 20.36 20.03 1 19.21 19.21 19.26 opriate 19.26	Nov 1 20.03 20.03 1 18.72 18.78 18.78	Dec 1 19.78 20.02 1 18.35 4) = 18.42 18.42			(8) (8) (8) (8) (8) (9) (9) (9) (9)
Temperature Jtilisation fac Jan 6)m= 1 Mean internal 7)m= 19.8 Temperature 8)m= 20.02 Jtilisation fac 9)m= 1 Mean internal 0)m= 18.36 Mean internal 0)m= 18.43 Apply adjustm 3)m= 18.43 8. Space heat	all temperative during he temperative 1 temperative 19.9 during he 20.02 temperative 1 temperative 1 temperative 18.52 temperative 18.59 temperative 18.59 temperative 18.59 temperative 18.59 temperative tot to the 18.59	rature (ating points for li Mar 1 20.1 20.02 ins for r 1 20.02 ins for r 1 18.81 ture in t 18.88 e mean 18.88 rement rnal ten	(healing eriods in iving are Apr 1 iving are 20.38 eriods in 20.03 est of du 0.99 the rest of 19.22 r the who 19.28 internal 19.28	season the livin a, h1,m May 0.98 a T1 (fc 20.64 rest of 20.03 welling, 0.96 of dwelli 19.61 temper 19.66 re obtain) ng area (see Ta Jun 0.9)) llow ste 20.84 dwelling 20.04 h2,m (se 0.84 ng T2 (f 19.87 lling) = f 19.92 ature fro 19.92	from Tai able 9a) Jul 0.76 eps 3 to 20.92 g from Tai 20.04 ee Table 0.63 follow ste 19.95 tLA × T1 20 m Table 20	ble 9, Th Aug 0.84 7 in Tab 20.9 able 9, T 20.9 able 9, T 20.04 9 9a) 0.73 eps 3 to 19.93 + (1 - ft 19.98 e 4e, wh 19.98	n1 (°C) Sep 0.98 le 9c) 20.71 h2 (°C) 20.03 0.97 7 in Tabl 19.71 19.76 ere appro-	Oct 1 20.36 20.03 1 19.21 19.21 19.26 opriate 19.26	Nov 1 20.03 20.03 1 18.72 18.78 18.78	Dec 1 19.78 20.02 1 18.35 4) = 18.42 18.42			(8) (8) (8) (8) (8) (9) (9) (9) (9) (9)

94)m=	1	1	ains, hm 1	0.99	0.96	0.83	0.62	0.72	0.96	1	1	1		(94)
Same St			. W = (94		1998-962	0.05	0.02	0.72	0.90		8			101
1910 March 1910					13863.63	12168.2	8731.49	8854.13	9697.66	7292.73	5123.2	4271.49		(95)
151 808	707				e from Ta	10 Carl 10 Carl	0101.40	0004.10	0001.00	1202.10	0120.2	421 1.40		100
6)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 intern	al temp	erature,	Lm,W:	=[(39)m :	x [(93)m	– (96)m	1				
7)m=	38571.4	37294.47	33649.62	27959.38	21399.65	14192.09	9061.79	9541.08	15137.08	23299.7	31529.76	38515.46		(97
Space	e heatin	g require	ement fo	r each n	nonth, k\	Nh/mon	th = 0.02	24 x [(97)m – (95)m] x (4	1)m			
98)m=	25157.75	20420.72	18004.61	11284.43	5606.8	0	0	0	0	11909.18	19012.72	25477.51		
								Tota	l per year	(kWh/year) = Sum(9	(8)1.53.12 =	136873.73	(98)
Space	e heatin	a reauire	ement in	kWh/m	/vear							Ī	54.19	(99
		• •										L		
			uiremen		See Tat	ale 10b								
Calcu	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat					<u> </u>							able 10)		
00)m=	0	0	0	0	0		19747.45		0	0	0	0		(10
Utilisa	ation fac	tor for lo	oss hm											
01)m=	0	0	0	0	0	0.65	0.76	0.68	0	0	0	0		(10
Usefu	I loss, h	mLm (V	vatts) = ((100)m >	(101)m									
02)m=	0	0	0	0	0	16427.14	14919.22	13710.78	0	0	0	0		(10
Gains	s (solar g	gains ca	lculated	for appl	cable we	eather re	egion, se	e Table	10)					
03)m=	0	D	0	0	0	17208.77	16388.15	14477.1	0	0	0	0		(10
						lwelling,	continue	ous (kN	/h) = 0.0	24 x [(10	03)m – (102)m] x	(41)m	
			(104)m <	1	-									
04)m=	0	0	0	0	0	562.77	1092.88	0	0	0	0	0		-
oolod	fraction									= Sum(cooled a		- -	1655.65	(10
			able 10b	1					10-	cooled	alea + (4	+) - L	0.59	(10
06)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		
			5.240						Tota	= Sum(104)	=	0	(10
pace	cooling	requirer	ment for	month =	(104)m	× (105)	× (106)r	m				L	10 0 /10	
07)m=	0	0	0	0	0	83.56	162.27	0	0	0	0	0		
						2		0	Total	= Sum(107)	=	245.83	(10
pace	cooling	requirer	ment in k	(Wh/m²/	/ear				(107) ÷ (4) =		ľ	0.1	(10
	-				eating sy	/stems i	ncluding	micro-C	(HP)			L		
4	e heatir			in addition	outing o	Peterner	norearing	THIOTO C						
			at from s	econdar	y/supple	mentary	system					Г	0.1	(20
			at from m					(202) = 1	- (201) =			F	0.9	(20
	5		ing from	59	0.000							L	0.1	(20
								(204) = (2)	02) × [1 –	(203)1=		Ļ	5.1410	=
			ng from									Ļ	0.81	(20
			ng from	ALCONTRACTOR				(205) = (2	02) × (203)=		Ĺ	0.09	(20)
		male and	ace heat	ing augt	h mar								319.7	(20

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Effic	iency of	main spa	ace heat	ting syste	em 2							Γ	93.3	(207)
Efficiency of secondary/supplementary heating system, %											Ī	80	(208)	
Cool	ling Syst	em Ener	gy Effici	ency Ra	tio							Ī	6.75	(209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ear
Spac				calculate)								
	25157.75	20420.72	18004.61	11284.43	5606.8	0	0	0	0	11909.18	19012.72	25477.51		
(211)	m = {[(98	3)m x (20	04)] } x *	100 ÷ (20)6)									(211)
	6374.03	5173.85	4561.69	2859.05	1420.55	0	0	0	0	3017.34	and the second	6455.05		_
								Tota	al (kWh/ye	ar) =Sum(211) _{1.510.1}	,	34678.67	(211)
		n x (203)												
(213)m	= 2426.79	1969.84	1736.78	1088.53	540.85	0	0	0	0	1148.8	10000000000000000000000000000000000000	2457.64		_
								Tota	il (kWh/ye	ar) =Sum()	213) _{15.101}	7	13203.25	(213)
		Conserve and		y), kWh/	month									
1.000	-	01)]}x1	1	1										
(215)m	= 3144.72	2552.59	2250.58	1410.55	700.85	0	0	0	0		2376.59			-
								lota	a (kvvn/ye	ar) =Sum(215) _{1.5.101}	2	17109.22	(215)
	r heating	10.00												
Outpu	424.14	374.82	395.95	358.14	353.28	318.99	309.52	335.28	333.32	371.21	388.5	415.01		
Efficie		vater hea		555.14	000.20	510.55	000.02	000.20	000.02	57 1.21	000.0	410.01	79.6	(216)
(217)m	<u> </u>	88.29	87.98	87.24	85.56	79.6	79.6	79.6	79.6	87.28	88.11	88.48	18.0	(217)
1. 1.		heating.		12.0	00.00	10.0	10.0	10.0	10.0	07.20	00.11	00.40		(2.1.)
)m x 100												
(219)m	479.66	424.53	450.05	410.51	412.88	400.74	388.85	421.21	418.74	425.3	440.93	469.06		
								Tota	l = Sum(2	(19a), ₁₂ =			5142.47	(219)
Spac	e coolin	g fuel, k	Wh/mo	nth.										1
		')m+ (20	1											
(221)m	=	0	0	0	0	12.38	24.04	0	0	0	0	0		_
								lota	al = Sum(2)	(21) _{a.n} =		L	36.42	(221)
	al totals									k	Wh/yea	· -	kWh/yea	r_
Space	e heating	g fuel use	ed, main	system	1							L	34678.67	
Space	e heating	g fuel use	ed, main	system	2							[13203.25	
Space	e heating	g fuel use	ed, seco	ndary								[17109.22	
Water	r heating	fuel use	d									[5142.47	
Space	e cooling	fuel use	ed									[36.42	
Electr	icity for p	pumps, f	ans and	electric	keep-ho	t								
cent	ral heatir	ng pump	\$									60		(230c)
boile	r with a	fan-assis	sted flue									45		(230e)
Total	electricit	y for the	above,	kWh/yea	r			sum	of (230a)	(230g) =			105	(231)
Electr	icity for I	ighting										Ī	2871.02	(232)
Electr	icity gen	erated b	y PVs									Ī	-3346.17	(233)
														_

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12a. CO2 emissions - Individual heating system	s includ	ling micro-CHP				
	Ene kWh	rgy i/year	Emission fa kg CO2/kWh		Emissions kg CO2/ye	-
Space heating (main system 1)	(211)	x	0.519	=	17998.23	(261)
Space heating (main system 2)	(213)	x	0.216	=	2851.9	(262)
Space heating (secondary)	(215)	x	0.216	=	3695.59	(263)
Water heating	(219)	x	0.216	=	1110.77	(264)
Space and water heating	(261)	+ (262) + (263) + (264) =			25656.5	(265)
Space cooling	(221)	×	0.519	=	18.9	(266)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	54.5	(267)
Electricity for lighting	(232)	x	0.519	=	1490.06	(268)
Energy saving/generation technologies Item 1			0.519	=	-1736.66	(269)
Total CO2, kg/year		sum	of (265)(271) =		25483.29	(272)
Dwelling CO2 Emission Rate		(272	?) + (4) =		10.09	(273)
El rating (section 14)					87	(274)

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APPENDIX (ii)

SAP L1A 2013/16 REGULATIONS

(SAP Worksheet)

		User Details:				
Assessor Name:	Ondrej Gajdos	Stroma N	lumber:	STRO	006629	
Software Name:	Stroma FSAP 2012	Software	Version:	Versio	n: 1.0.5.7	
		Property Address: 28	, Avenue Road			
Address :	28, Avenue Road, LONDO	N, NW8 6BU				
1. Overall dwelling dim	ensions:					
Decement		Area(m ²)	Av. Height(r		Volume(m ³	<u> </u>
Basement		789.3 (1a)	× 3.3	(2a) =	2604.69	(3a
Ground floor		617 (1b)	× 5.5	(2b) =	3393.5	(3)
First floor		570.3 (1c)	× 4.2	(2c) =	2395.26	(30
Second floor		549 (1d)	× 3.1	(2d) =	1701.9	(30
Total floor area TFA = (1	la)+(1b)+(1c)+(1d)+(1e)+(1	n) 2525.6 (4)				20
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)	+(3n) =	10095.35	(5)
2. Ventilation rate:	- 53					
	main seconda heating heating	ry other	total		m ³ per hou	r
Number of chimneys	0 + 0	+ 0	= 0	×40 =	0	(6
Number of open flues	0 + 0	+ 4	= 4	x 20 =	80	(6
Number of intermittent fa	ans		16	x 10 =	160	(7
Number of passive vents	5		0	x 10 =	0	(7
Number of flueless gas t	fires		0	x 40 =	0	(7
				Air ch	anges per ho	our
Infiltration due to chimne	eys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	240	÷ (5) =	0.02	(8)
	been carried out or is intended, procee		nue from (9) to (16)	-	10.0548 5 -	
Number of storeys in t	the dwelling (ns)			[0	(9)
Additional infiltration				[(9)-1]x0.1 =	0	(1
	0.25 for steel or timber frame o			[0	(1
if both types of wall are p deducting areas of open	present, use the value corresponding t ings): if equal user 0.35	o the greater wall area (af	ter			
	floor, enter 0.2 (unsealed) or 0	.1 (sealed), else ente	er O	ſ	0	(1
If no draught lobby, er	nter 0.05, else enter 0			Ì	0	(1
Percentage of window	s and doors draught stripped			Ì	0	(1
Window infiltration		0.25 - [0.2 x (1	4) + 100] =	Ì	0	(1
Infiltration rate		(8) + (10) + (11	1) + (12) + (13) + (15) =	• Î	0	(1
Air permeability value	, q50, expressed in cubic metre	es per hour per squa	re metre of envelo	pe area	4	(1
If based on air permeab	ility value, then (18) = [(17) + 20]+	(8), otherwise (18) = (16)		Ì	0.22	(1
Air permeability value appli	es if a pressurisation test has been do	ne or a degree air permea	bility is being used	0.8		
Number of sides shelter	ed		5. N. 1.	[0	(1
Shelter factor		(20) = 1 - [0.07	eren and the	[1	(2
Infiltration rate incorpora	ting shelter factor	(21) = (18) x (2	20) =	[0.22	(2
Infiltration rate modified	for monthly wind speed					

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22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7		
				1		÷	· · · · ·							
-			(22)m ÷									<u> </u>		
22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
djusted	d infiltra	ation rat	e (allowi	ng for s	helter an	nd wind s	speed) =	(21a) x	(22a)m					
and the second second second	0.29	0.28	0.27	0.25	0.24	0.21	0.21	0.21	0.22	0.24	0.25	0.26		
		<i>ctive air</i> al ventila		rate for t	the appli	cable ca	ise					Г	0	(23a)
lf exhau	ust air he	eat pump	using App	endix N, (2	23b) = (23a	a) × Fmv (equation (N5)), othe	rwise (23b) = (23a)		F	0	(23b)
lf balan	ced with	heat reco	overy: effic	iency in %	allowing	for in-use f	lactor (from	n Table 4h) =				0	(23c)
a) If ba	alance	d mech	anical ve	entilation	with he	at recov	ery (MV	HR) (24a	a)m = (2:	2b)m + (23b) × [1 – (23c) ÷	100]	
a) If ba 24a)m=	alance 0	d mech	anical ve 0	ontilation	with he	at recov	ery (MV	HR) (24a	a)m = (2: 0	2b)m + (0	23b) × [0	1 – (23c) +	100]	(24a)
24a)m=	0	0	0	0	0	0	0	0	<u>í</u>	0	0	r í	100]	(24a)
24a)m=	0	0	0	0	0	0	0	0	0	0	0	r í	100]	
24a)m= b) If ba 24b)m= c) If w	0 alance 0 hole h	0 ed mech 0 ouse ex	0 anical ve 0 tract ver	0 entilation 0 ntilation (0 without 0 or positiv	0 heat red 0 ve input	o covery (l o ventilatio	0 MV) (24t 0 on from (0 0)m = (22 0	0 2b)m + (0	0 23b) 0	0	100]	
24a)m= b) If ba 24b)m= c) If w	0 alance 0 hole h	0 ed mech 0 ouse ex	0 anical ve 0 tract ver	0 entilation 0 ntilation (0 without 0 or positiv	0 heat red 0 ve input	o covery (l o ventilatio	0 MV) (24t 0 on from (0)m = (22 0 0 0 0 0	0 2b)m + (0	0 23b) 0	0	100]	(24b)
24a)m= b) If ba 24b)m= c) If w if (24c)m= d) If na	0 alance 0 hole h (22b)n 0 atural 1	0 od mech 0 ouse ex n < 0.5 > 0 ventilatio	0 anical ve tract ver < (23b), 1 0 on or wh	0 entilation 0 ntilation (hen (24 0 ole hous	0 without 0 or positiv c) = (23t 0 se positiv	0 heat red 0 ve input b); othen 0 ve input	0 covery (I 0 ventilation wise (24 0 ventilation	0 MV) (24t 0 on from (c) = (22t 0 0 on from	0)m = (22 0 0 0 0 0 0 0 0 0	0 2b)m + (, 0 5 × (23t	0 23b) 0	0	100]	(24b)
24a)m= b) If ba 24b)m= c) If w if (24c)m= d) If na if (0 alance 0 hole h (22b)n 0 atural 1	0 od mech 0 ouse ex n < 0.5 > 0 ventilatio	0 anical ve tract ver < (23b), 1 0 on or wh	0 entilation 0 ntilation (hen (24 0 ole hous	0 without 0 or positiv c) = (23t 0 se positiv	0 heat red 0 ve input b); othen 0 ve input	0 covery (I 0 ventilation wise (24 0 ventilation	0 MV) (24t 0 on from (c) = (22t 0 0 on from	0)m = (22 0 0 0 0 0 0 0 0 0 0 0 0	0 2b)m + (, 0 5 × (23t	0 23b) 0	0	100]	(24b) (24c)
24a)m= b) If b: 24b)m= c) If w if u 24c)m= d) If na if u 24d)m=	0 alance 0 thole h (22b)n 0 atural 1 (22b)n 0.54	0 d mech 0 ouse ex n < 0.5 > 0 ventilation n = 1, th 0.54	0 anical ve tract ver (23b), 1 0 0 or or wh en (24d) 0.54	0 entilation o tilation (24 0 ole hous m = (22 0.53	0 without 0 or positiv c) = (23t 0 se positiv b)m othe 0.53	0 heat red ve input 0 ve input ve input enwise (2	0 covery (I 0 ventilatio wise (24 0 ventilati 24d)m = 0.52	0 MV) (24t 0 on from 0 c) = (22t 0 on from 0.5 + [(2 0.52	0)m = (22 0 outside b) m + 0. 0 loft (2b)m ² x 0.53	0 2b)m + (0 5 × (23t 0 0.5]	0 23b) 0)) 0	0	100]	(24b)

	Gross rea (m²)	Openings m ²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²-K	A X k kJ/K
Doors			6.28	x 1.3	= 8.164		(26)
Windows Type 1			4.79	x1/[1/(1.3)+0.04]	= 5.92		(27)
Windows Type 2			13.04	x1/[1/(1.3)+0.04]	= 16.11		(27)
Windows Type 3			16.83	x1/[1/(1.3)+0.04]	= 20.8		(27)
Windows Type 4			7.19	x1/[1/(1.3)+ 0.04]	8.88		(27)
Windows Type 5			3.38	x1/[1/(1.3)+0.04]	= 4.18		(27)
Windows Type 6			2.73	x1/[1/(1.3)+ 0.04]	= 3.37		(27)
Windows Type 7			1.96	x1/[1/(1.3)+0.04]	= 2.42		(27)
Windows Type 8			5.58	x1/[1/(1.3)+0.04]	= 6.9		(27)
Windows Type 9			3.38	x1/[1/(1.3)+ 0.04]	= 4.18		(27)
Windows Type 10			2.73	x1/[1/(1.3)+0.04]	= 3.37		(27)
Windows Type 11			1.96	x1/[1/(1.3)+ 0.04]	= 2.42		(27)
Windows Type 12			11.16	x1/[1/(1.3)+ 0.04]	= 13.79		(27)
Windows Type 13			5.58	x1/[1/(1.3)+ 0.04]	= 6.9		(27)

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Window	ws Type	14				2.73	×1	/[1/(1.3)+	0.041 =	3.37				(27)
	ws Type					5.4		/[1/(1.3)+		6.67	=			(27)
Window	ws Type	16				1.96		/[1/(1.3)+	0.04] =	2.42	Ħ			(27)
Window	ws Type	17				4.08	x1	/[1/(1.3)+	0.04] =	5.04	Ħ			(27)
Window	ws Type	18				3.38		/[1/(1.3)+	0.04] =	4.18	=			(27)
Window	ws Type	19				5.58	x1	/[1/(1.3)+	0.04] =	6.9	Ħ			(27)
Window	ws Type	20				2.73	x1	/[1/(1.3)+	0.04] =	3.37	f			(27)
Window	ws Type	21				3.9	x1	/[1/(1.3)+	0.04] =	4.82	Ħ			(27)
Window	ws Type	22				1.96	x1	/[1/(1.3)+	0.04] =	2.42	Ŧ.			(27)
Rooflig	hts					46.34	x1	/[1/(1.3) +	0.04] =	60.242	1			(27b)
Floor T	ype 1					789.3	x	0.12	=	94.716	Πr			(28)
Floor T	ype 2					29.2	×	0.12	= i	3.504	ΪĒ		i —	(28)
Walls T	Гуре1	350.	79	0		350.7	9 ×	0.15	=	52.62	ī ī		i —	(29)
Walls 1	Гуре2	1116	.81	275.5	1	841.3	x	0.18	=	151.43	īī		i —	(29)
Walls 1	Гуре3	123	.7	33.4	3	90.22	x	0.18	=	16.24	ĪĒ		i —	(29)
Roof 1	Гуре1	153	.3	0		153.3	x	0.12	=	18.4	ΞĒ		i —	(30)
Roof 7	Гуре2	21.3	3	0		21.3	×	0.12	=	2.56				(30)
Roof 1	ГуреЗ	360	.1	46.3	4	313.7	6 X	0.12	=	37.65				(30)
Roof 7	Гуре4	263	.8	0		263.8	×	0.12	=	31.66				(30)
Roof 7	Гуре5	37.6	6	0		37.6	x	0.12	=	4.51]	(30)
12	roo of o	lamonte	m2			-								-
Total a	lea or e	lements	, 111			3245.	9							(31)
* for win	dows and	roof winde	ows, use e			niue calcul		formula 1	/[(1/U-valu	e)+0.04] a	s given in	paragraph 3	3.2	(31)
* for win ** includ	dows and le the area	roof winde is on both	ows, use e sides of in	nternal wal		niue calcul	ated using			e)+0.04] a	s given in	paragraph 3		-
* for win ** includ Fabric	dows and le the area heat los	roof winde is on both is, W/K =	ows, use e sides of in = S (A x	nternal wal		niue calcul	ated using	formula 1 (26)(30)	+ (32) =			Ę	852.78	(33)
* <i>for win</i> ** <i>includ</i> Fabric Heat c	dows and le the area heat los apacity (roof winde is on both is, W/K = Cm = S(ows, use e sides of in = S (A x (A x k)	nternal wal U)	s and part	lue calcul itions	ated using		+ (32) = ((28).	e)+0.04] a .(30) + (32 tive Value:	2) + (32a).	Ę	852.78 0	(33) (34)
* for wind ** includ Fabric Heat co Therma	dows and e the area heat los apacity f al mass	roof winde is on both is, W/K = Cm = S(parame	ows, use e sides of in = S (A x (A x k) tter (TMF	nternal wal U) P = Cm -	s and part	itions kJ/m²K	ated using	(26)(30	+ (32) = ((28) Indica	.(30) + (32	2) + (32a). Medium	(32e) = [852.78	(33)
* for win ** includ Fabric Heat c Therm For desig	dows and e the area heat los apacity l al mass gn assess used instea	roof windo is on both is, W/K = Cm = S(parame iments wh ad of a dei	ows, use e sides of in = S (A x (A x k) tter (TMF ere the de tailed calcu	nternal wal U) P = Cm - tails of the ulation.	s and part - TFA) in constructi	itions itions kJ/m²K ion are not	ated using	(26)(30	+ (32) = ((28) Indica	.(30) + (32 tive Value:	2) + (32a). Medium	(32e) = [852.78 0 250	(33) (34) (35)
* for wind ** includ Fabric Heat c Therm For designed Can be d	dows and e the area heat los apacity al mass gn assess used instea al bridge	roof winde is on both is, W/K = Cm = S(parame ments wh ad of a del es : S (L	ows, use e sides of in = S (A x (A x k) eter (TMF ere the de tailed calco x Y) cal	ternal wal U) = = Cm - tails of the ulation. culated (TFA) in constructi using Ap	itions kJ/m²K on are not	ated using	(26)(30	+ (32) = ((28) Indica	.(30) + (32 tive Value:	2) + (32a). Medium	(32e) = [852.78 0	(33) (34)
* for win ** includ Fabric Heat c Therm For desin can be u Therm if details	dows and e the area heat los apacity al mass gn assess used instea al bridge	roof winde is on both is, W/K = Cm = S(parame ments wh ad of a del es : S (L Il bridging	ows, use e sides of in = S (A x (A x k) eter (TMF ere the de tailed calco x Y) cal	nternal wal U) P = Cm - tails of the ulation.	TFA) in constructi using Ap	itions kJ/m²K on are not	ated using	(26)(30	+ (32) = ((28) Indica indicative	.(30) + (32 tive Value:	2) + (32a). Medium	(32e) = [852.78 0 250 74.78	(33) (34) (35) (36)
* for wini ** includ Fabric Heat c Therm For desin can be u Therm if details Total fa	dows and le the area heat los apacity l al mass gn assess used instea al bridge of therma abric he	roof windd is on both is, W/K = Cm = S(parame ments wh ad of a del as : S (L il bridging at loss	ows, use e sides of in = S (A x (A x k) ter (TMF ere the de tailed calco x Y) Cal are not kn	ternal wal U) = = Cm - tails of the ulation. culated (TFA) in constructi using Ap 0.05 x (3	itions kJ/m²K on are not	ated using	(26)(30	+ (32) = ((28) Indica indicative (33) +	.(30) + (32 tive Value: values of	r) + (32a) Medium TMP in Ta	(32e) = [bble 1f	852.78 0 250	(33) (34) (35)
* for wini ** includ Fabric Heat c Therm For desin can be u Therm if details Total fa	dows and le the area heat los apacity l al mass gn assess used instea al bridge of therma abric he	roof windd is on both is, W/K = Cm = S(parame ments wh ad of a del as : S (L il bridging at loss	ows, use e sides of in = S (A x (A x k) ter (TMF ere the de tailed calco x Y) Cal are not kn	D = Cm - tails of the ulation. culated (own (36) =	TFA) in constructi using Ap 0.05 x (3	itions kJ/m²K on are not	ated using	(26)(30	+ (32) = ((28) Indica indicative (33) +	.(30) + (32 tive Value: values of (36) =	r) + (32a) Medium TMP in Ta	(32e) = [bble 1f	852.78 0 250 74.78	(33) (34) (35) (36)
* for wini ** includ Fabric Heat c Therm For desin can be u Therm if details Total fa	dows and te the area heat los apacity al mass gn assess used instea of therma abric hea tion hea	roof windd is on both is, W/K = Cm = S(parame ments wh ad of a del es : S (L il bridging at loss at loss ca	ows, use e sides of ir = S (A x (A x k) ter (TMF ere the de tailed calc x Y) cal are not kn alculatec	D = Cm - tails of the ulation. culated iown (36) =	- TFA) in constructi using Ap 0.05 x (3	lue calcul itions I kJ/m²K ion are not pendix I 1)	ated using ' known pr	(26)(30	(28) = ((28) Indica indicative (33) + (38)m	.(30) + (32 tive Value: values of (36) = = 0.33 × ()	2) + (32a). Medium TMP in Ta 25)m x (5)	(32e) = [bble 1f	852.78 0 250 74.78	(33) (34) (35) (36)
* for wini ** includ Fabric Heat C Therm For design can be u Therm if details Total fa Ventila (38)m=	dows and te the area heat los apacity al mass gn assess sed instea al bridge of therma abric hea tion hea Jan 1801.33	roof windd is on both is, W/K = Cm = S(parame ments wh ad of a del as : S (L Il bridging at loss at loss ca Feb	ows, use e sides of in = S (A x (A x k) ter (TMF ere the de tailed calc: x Y) cal are not kn alculatec Mar 1790.9	D = Cm - tails of the ulation. culated i own (36) = d monthly Apr	- TFA) in constructi using Ap c 0.05 x (3 / May	lue calcul itions h kJ/m²K on are not pendix H 1) Jun	ated using known pr C	(26)(30 ecisely the	(28)	.(30) + (32 tive Value: values of (36) = = 0.33 × (Oct	25)m x (5) Nov 1771.3	(32e) = [[[[] [] [] [] [] [] [] [] [] [] [] [852.78 0 250 74.78	(33) (34) (35) (36) (37)
* for winn ** includ Fabric Heat c Therm For desi can be u Therm if details Total fa Ventila (38)m= Heat tr	dows and e the area heat los apacity i al mass gn assess sed instea al bridge of therma abric hea tion hea Jan 1801.33	roof windd is on both is, W/K = Cm = S(parame ments wh ad of a del es : S (L I bridging at loss at loss ca Feb 1796.06	ows, use e sides of in = S (A x (A x k) ter (TMF ere the de tailed calci x Y) cal are not kn alculatec Mar 1790.9	D = Cm - tails of the ulation. culated i own (36) = d monthly Apr	s and part TFA) in constructi using Ap 0.05 x (3 May 1762.12	lue calcul itions h kJ/m²K on are not pendix H 1) Jun	ated using known pr C	(26)(30 ecisely the Aug 1737.1	+ (32) = ((28) Indica i indicative (33) + (38) m Sep 1749.14 (39) m 2676.71	.(30) + (32 tive Value: values of (36) = = 0.33 × () Oct 1762.12 = (37) + (3 2689.69	2) + (32a). Medium <i>TMP in Ta</i> 25)m x (5) Nov 1771.3 38)m 2698.86	(32e) = [852.78 0 250 74.78 927.56	(33) (34) (35) (36) (37) (38)
* for winn ** includ Fabric Heat c Therm. For desi, can be u Therm. if details Total fa Ventila (38)m= Heat tr (39)m=	dows and e the area heat los apacity i al mass gn assess sed instea al bridge of therma abric hea tion hea Jan 1801.33 ransfer c 2728.89	roof windd is on both is, W/K = Cm = S(parame ments wh ad of a del es : S (L Il bridging at loss at loss ca Feb 1796.06 coefficier 2723.63	ows, use e sides of in = S (A x (A x k) ter (TMF ere the de tailed calci x Y) cal are not kn alculatec Mar 1790.9 nt, W/K 2718.46	Appr 1766.66 2694.22	s and part TFA) in constructi using Ap 0.05 x (3 May 1762.12	lue calcul itions kJ/m²K on are not pendix H 1) Jun 1741.01	ated using known pr Jul 1741.01	(26)(30 ecisely the Aug 1737.1	+ (32) = ((28) Indica i indicative (33) + (38)m Sep 1749.14 (39)m 2676.71	.(30) + (32 tive Value: values of (36) = = 0.33 × () Oct 1762.12 = (37) + (5 2689.69 Average =	2) + (32a). Medium <i>TMP in Ta</i> 25)m x (5) Nov 1771.3 38)m 2698.86 Sum(39),	(32e) = [852.78 0 250 74.78	(33) (34) (35) (36) (37)
* for winn ** includ Fabric Heat c Therm. For desi, can be u Therm. if details Total fa Ventila (38)m= Heat tr (39)m=	dows and e the area heat los apacity i al mass gn assess sed instea al bridge of therma abric hea tion hea Jan 1801.33 ransfer c 2728.89	roof windd is on both is, W/K = Cm = S(parame ments wh ad of a del es : S (L Il bridging at loss at loss ca Feb 1796.06 coefficier 2723.63	ows, use e sides of in = S (A x (A x k) ter (TMF ere the de tailed calci x Y) cal are not kn alculatec Mar 1790.9	Appr 1766.66 2694.22	s and part TFA) in constructi using Ap 0.05 x (3 May 1762.12	lue calcul itions kJ/m²K on are not pendix H 1) Jun 1741.01	ated using known pr Jul 1741.01	(26)(30 ecisely the Aug 1737.1	+ (32) = ((28) Indica i indicative (33) + (38)m Sep 1749.14 (39)m 2676.71	.(30) + (32 tive Value: values of (36) = = 0.33 × () Oct 1762.12 = (37) + (3 2689.69	2) + (32a). Medium <i>TMP in Ta</i> 25)m x (5) Nov 1771.3 38)m 2698.86 Sum(39),	(32e) = [852.78 0 250 74.78 927.56	(33) (34) (35) (36) (37) (38)
* for winn ** includ Fabric Heat c Therm For desi can be u Therm if details Total fa Ventila (38)m= Heat tr (39)m= Heat lc (40)m=	dows and e the area heat los apacity i al mass gn assess ised instea al bridge of therma abric hea Jan 1801.33 ansfer c 2728.89 oss para 1.08	roof windd is on both is, W/K = Cm = S(parame ments wh ad of a del as : S (L il bridging at loss tt loss ca Feb 1796.06 coefficier 2723.63 meter (H	ows, use e sides of in = S (A x (A x k) ter (TMF ere the de tailed calc: x Y) cal are not kn alculatec Mar 1790.9 nt, W/K 2718.46 HLP), W/ 1.08	Apr 1766.66 2694.22 1.07	- TFA) in constructi using Ap 0.05 x (3 / May 1762.12 2689.69	lue calcul itions h kJ/m ² K on are not pendix H 1) Jun 1741.01 2868.57	ated using known pr Jul 1741.01 2668.57	(26)(30) ecisely the Aug 1737.1 2664.66	+ (32) = ((28) Indica indicative (33) + (38)m Sep 1749.14 (39)m 2676.71	.(30) + (32 tive Value: values of (36) = = 0.33 × (Oct 1762.12 = (37) + (3 2689.69 Average = = (39)m +	2) + (32a) Medium TMP in Ta 25)m × (5) Nov 1771.3 38)m 2698.86 Sum(39), (4) 1.07	(32e) = [[] [] [] [] [] [] [] [] [] [852.78 0 250 74.78 927.56	(33) (34) (35) (36) (37) (38)
* for winn ** includ Fabric Heat c Therm For desi can be u Therm if details Total fa Ventila (38)m= Heat tr (39)m= Heat lc (40)m=	dows and e the area heat los apacity i al mass gn assess ised instea al bridge of therma abric hea Jan 1801.33 cansfer co 2728.89 oss para 1.08	roof winde is on both is, w/K = Cm = S(parame ments wh ad of a del es : S (L il bridging at loss tt loss ca Feb 1796.06 coefficier 2723.63 meter (H 1.08	ows, use e sides of in = S (A x (A x k) ter (TMF ere the de tailed calcu x Y) cal are not kn alculated Mar 1790.9 nt, W/K 2718.46 HLP), W/ 1.08	Internal wal U) C = Cm - tails of the ulation. culated in iown (36) = d monthl: Apr 1766.66 2694.22 (m ² K 1.07 le 1a)	- TFA) in constructi using Ap • 0.05 x (3 / May 1762.12 2689.69 1.06	lue calculi itions kJ/m ² K on are not pendix H 1) 1741.01 2668.57 1.06	ated using known pr Jul 1741.01 2668.57 1.06	(26)(30) ecisely the 1737.1 2664.66 1.06	+ (32) = ((28) Indica indicative (33) + (38)m Sep 1749.14 (39)m 2676.71 (40)m 1.06	.(30) + (32 tive Value: values of (36) = = 0.33 × (Oct 1762.12 = (37) + (3 2689.69 Average = = (39)m + 1.06 Average =	2) + (32a) Medium <i>TMP in Ta</i> 25)m × (5) Nov 1771.3 38)m 2698.86 Sum(39), (4) 1.07 Sum(40),	(32e) = [852.78 0 250 74.78 927.56 2694.2	(33) (34) (35) (36) (37) (38) (38)
* for winn ** includ Fabric Heat c Therm For desi can be u Therm if details Total fa Ventila (38)m= Heat tr (39)m= Heat lc (40)m=	dows and e the area heat los apacity i al mass gn assess ised instea al bridge of therma abric hea Jan 1801.33 ansfer c 2728.89 oss para 1.08	roof windd is on both is, W/K = Cm = S(parame ments wh ad of a del as : S (L il bridging at loss tt loss ca Feb 1796.06 coefficier 2723.63 meter (H	ows, use e sides of in = S (A x (A x k) ter (TMF ere the de tailed calc: x Y) cal are not kn alculatec Mar 1790.9 nt, W/K 2718.46 HLP), W/ 1.08	Apr 1766.66 2694.22 1.07	- TFA) in constructi using Ap 0.05 x (3 / May 1762.12 2689.69	lue calcul itions h kJ/m ² K on are not pendix H 1) Jun 1741.01 2868.57	ated using known pr Jul 1741.01 2668.57	(26)(30) ecisely the Aug 1737.1 2664.66	+ (32) = ((28) Indica indicative (33) + (38)m Sep 1749.14 (39)m 2676.71	.(30) + (32 tive Value: values of (36) = = 0.33 × (Oct 1762.12 = (37) + (3 2689.69 Average = = (39) m + 1.06	2) + (32a) Medium TMP in Ta 25)m × (5) Nov 1771.3 38)m 2698.86 Sum(39), (4) 1.07	(32e) = [[] [] [] [] [] [] [] [] [] [852.78 0 250 74.78 927.56 2694.2	(33) (34) (35) (36) (37) (38) (38)

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4. Water hea	iting ene	rgy requ	irement:								kWh/yea	ar:	
Assumed occi if TFA > 13. if TFA £ 13.	.9, N = 1		: [1 - exp	·(-0.0003	349 x (TF	=A -13.9)2)] + 0.(0013 x (TFA -13		.03		(42)
nnual averag	ial average	hot water	usage by	5% if the d	lwelling is	designed			se target c		7.3		(43)
ot more that 125	s litres per	person per	r day (all w	rater use, f	hot and co	id)							
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
ot water usage	in litres pe	r day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)						
14)m= 195.03	187.94	180.84	173.75	166.66	159.57	159.57	166.66	173.75	180.84	187.94	195.03		
nergy content o	f hot water	used - cal	culated m	onthly = 4.	190 x Vd,i	n x nm x L) Tm / 3600			um(44) ₁₁₂ ables 1b, 1		2127.58	(44
5)m= 289.22	252.96	261.03	227.57	218.36	188.43	174.61	200.36	202.75	236.29	257.93	280.1		
	1. And 1.								Total = Su	Im(45)	=	2789.6	(45
instantaneous v	water heati	ing at point	of use (no	hot water	r storage),	enter 0 in	boxes (46						0
46)m= 43.38	37.94	39.15	34.14	32.75	28.26	26.19	30.05	30.41	35.44	38.69	42.01		(46)
Vater storage	loss:												
itorage volun	ne (litres)) includir	ng any se	olar or W	WHRS	storage	within sa	ame ves	sel		2000		(47
community I	heating a	and no ta	unk in dw	velling, e	nter 110	litres in	(47)						
therwise if n	o stored	hot wate	er (this in	icludes i	nstantar	neous co	mbi boil	ers) ente	er 'O' in i	(47)			
/ater storage	loss:									ar ar			
a) If manufac	turer's d	eclared I	oss facte	or is kno	wn (kW	n/day):				6	.67		(48
emperature	factor fro	m Table	2b							0	.54		(49
nergy lost fro	om wate	r storage	, kWh/y	ear			(48) x (49) =		3	5.6		(50
b) If manufac	turer's d	eclared of	cylinder	loss fact	or is not	known:							
lot water stor	rage loss	factor fr	om Tab	e 2 (kW	h/litre/da	iy)					0		(51
f community I			on 4.3										
olume factor											0		(52
emperature t	factor fro	m Table	2b								0		(53
inergy lost fro	om water	r storage	, kWh/ye	ar			(47) x (51)) x (52) x (53) =		0		(54
Enter (50) or	(54) in (55)								3	6.6		(55
Vater storage	loss cal	lculated t	for each	month			((56)m = (55) × (41)	m				
6)m= 111.66	100.85	111.66	108.05	111.66	108.05	111.66	111.66	108.05	111.66	108.05	111.66		(56
cylinder contain	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	om Appendix	н	
7)m= 111.66	100.85	111.66	108.05	111.66	108.05	111.66	111.66	108.05	111.66	108.05	111.66		(57
111.00	100.00	111.00	100.00	111.00	100.05	111.00	111.00	100.00	111.00	100.00	111.00		
rimary circui											0		(58
rimary circui				Surger and and a	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	1	and and the second		1000	- 275.25			
(modified by	y factor f	rom Tab	le H5 if t	here is s	solar wa	ter heati	ng and a	cylinde	r thermo	ostat)			
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
ombi loss ca	alculated	for each	month	(61)m =	(60) ÷ 30	65 × (41)m						
61)m= 0	0	0	0	0	0	0	0	0	0	0	0		(61
otal heat req	uired for	water h	eating or	alculated	for eac	h month	(62)m =	0.85 ×	(45)m +	(46)m +	(57)m + (59)m + (61)	m
62)m= 424.14		395.95	358.14	353.28	318.99	309.52	335.28	333.32	371.21	388.5	415.01	/	(62
444.14	Cale of a constant	S an ann - connti		California de la person	in a construction of the	Sector sector sector	internation of a	Carl Contractor Contractor	Reaction and second	and an and a state of the state			1.2
olar DHM innet	calculated	using App							Contribut	non to wate	er neating)		
iolar DHW input	I lince if	ECHDO	andlar										
olar DHW input add additiona	al lines if	FGHRS 0	and/or \	/WHRS	applies 0	, see Ap	0 pendix C)	0	0	0		(63

64)m=	424.14	374.82	395.95	358.14	353.28	318,99	309.52	335.28	333.32	371.21	388.5	415.01		
								Outp	out from w	ater heate	(annual)	12	4378.15	(64
leat g	ains from	m water	heating,	kWh/m	onth 0.2	5 ′ [0.85	× (45)m	+ (61)m	1] + 0.8 >	c [(46)m	+ (57)m	+ (59)m]		-
65)m=	204.1	181.6	194.73	180.12	180.54	167.1	165.99	174.55	171.87	186.5	190.21	201.07		(65)
inclu	ide (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	ater is fr	om com	munity hea	ating	
5. Int	ternal da	ains (see	Table 5	and 5a):									
			5), Wat											
letab	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
i6)m=	361.51	361.51	361.51	361.51	361.51	361.51	361.51	361.51	361.51	361.51	361.51	361.51		(66
ightin	g gains	(calcula	ted in Ap	pendix	L, equat	ion L9 o	r L9a), a	lso see '	Table 5		P.			
7)m=	406.42	360.98	293.57	222.25	166.13	140.26	151.55	197	264.41	335.73	391.84	417.72		(67
pplia	nces da	ins (calc	ulated ir	Append	dix L. eq	uation L	13 or L1	3a), also	see Ta	ble 5				
=m(8	2541.88	2568.25	2501.78	2360.28	2181.66	2013.78	1901.62	1875.25	1941.71	2083.22	2261.84	2429.72		(68
ookin	ng gains	(calcula	ted in A	ppendix	L, equat	ion L15	or L15a	, also se	e Table	5	0			
9)m=	77.18	77.18	77.18	77.18	77.18	77.18	77.18	77.18	77.18	77.18	77.18	77.18		(69
umps	and fai	ns cains	(Table 5	ja)							2			
70)m=	6	6	6	6	6	6	6	6	6	6	6	6		(70
osses	se.a. ev	aporatio	n (nega	tive valu	es) (Tab	le 5)						<u> </u>		
(1)m=	-241.01		-241.01	-241.01	-241.01	-241.01	-241.01	-241.01	-241.01	-241.01	-241.01	-241.01		(71
Vater	heating	gains (T	able 5)									·		
2)m=	274.33	270.23	261.73	250.17	242.66	232.09	223.11	234.62	238.71	250.67	264.19	270.25		(72
otal i	nternal	qains =				(66)	m + (67)m	1 + (68)m +	(69)m +	(70) m + (7	1)m + (72)	m		
73)m=	3426.31	3403.15	3260.76	3036.38	2794.13	2589.81	2479.96	2510.54	2648.51	2873.3	3121.55	3321.37		(73
6. Sol	lar gains					a:								
Solar g	ains are c	alculated	using sola	r flux from	Table 6a	and assoc	iated equa	tions to co	nvert to th	e applicab	le orientat	tion.		
	ation: A	Access F	actor	Area		Flu	x		g_		FF		Gains	
rienta														

	Та	ble 6d		m²		Table 6a		Table 6b	T	able 6c		(W)	
North	0.9x	0.77	×	11.16	×	10.63] × [0.63] × [0.7	=	72.53	(74)
North	0.9x	0.77	×	5.58	x	10.63	×	0.63	x	0.7	=	90.67	(74)
North	0.9x	0.77	×	2.73	×	10.63	×	0.63	x	0.7	=	53.23	(74)
North	0.9x	0.77	×	5.4	×	10.63) × [0.63) × [0.7	=	17.55	(74)
North	0.9x	0.77	×	1.96	×	10.63) × [0.63	×	0.7	=	25.48	(74)
North	0.9x	0.77	×	4.08	×	10.63	x [0.63] × [0.7	=	13.26	(74)
North	0.9x	0.77	×	11,16	×	20.32	× [0.63	×	0.7	=	138.61	(74)
North	0.9x	0.77	×	5.58	×	20.32) × [0.63] × [0.7	=	173.27	(74)
North	0.9x	0.77	×	2.73	×	20.32	×	0.63) × [0.7	=	101.73	(74)
North	0.9x	0.77	×	5.4	×	20.32) × [0.63] × [0.7] = [33.54	(74)
North	0.9x	0.77	×	1.96	x	20.32) × [0.63) × [0.7] = [48.69	(74)
North	0.9x	0.77	×	4.08	×	20.32] × [0.63) × [0.7] = [25.34	(74)

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SAP	WorkSheet:	New	dwelling	design	stage

North	0.9x	0.77	×	11.16	×	34.53	×	0.63] × [0.7] = [235.54	(74)
North	0.9x	0.77	×	5.58	ī × ī	34.53	ī × ī	0.63	i x i	0.7	i - F	294.43	(74)
North	0.9x	0.77	×	2.73	Ī×Ī	34.53	ī × ī	0.63	i × ľ	0.7	i <u>-</u> F	172.86	(74)
North	0.9x	0.77	×	5.4] × [34.53	1 × [0.63	i × i	0.7	ī - Г	56.99	(74)
North	0.9x	0.77	x	1.96	×	34.53	1 × [0.63	X	0.7	i - F	82.73	(74)
North	0.9x	0.77	×	4.08	×	34.53	×	0.63	İ x İ	0.7	<u>1 - F</u>	43.06	(74)
North	0.9x	0.77	×	11.16	×	55.46	× [0.63] × [0.7	ī = [378.34	(74)
North	0.9x	0.77	×	5.58	×	55.46	×	0.63] x [0.7] = [472.92	(74)
North	0.9x	0.77	×	2.73	×	55.46	× [0.63] × [0.7] = [277.65	(74)
North	0.9x	0.77	×	5.4	×	55.46	×	0.63	x	0.7	- [91.53	(74)
North	0.9x	0.77	×	1.96	×	55.46	×	0.63	x	0.7	=	132.89	(74)
North	0.9x	0.77	×	4.08) × [55.46	×	0.63] × [0.7	= [69.16	(74)
North	0.9x	0.77	×	11.16	x	74.72	×	0.63	x	0.7	=	509.66	(74)
North	0.9x	0.77	x	5.58	×	74.72	×	0.63] × [0.7	= [637.07	(74)
North	0.9x	0.77	×	2.73	×	74.72	×	0.63	×	0.7	=	374.02	(74)
North	0.9x	0.77	×	5.4	×	74.72	×	0.63] × [0.7] = [123.3	(74)
North	0.9x	0.77	×	1.96	×	74.72	×	0.63	x	0.7	=	179.02	(74)
North	0.9x	0.77	×	4.08	×	74.72	×	0.63] × [0.7] = [93.16	(74)
North	0.9x	0.77	×	11.16	×	79.99	×	0.63] × [0.7	=	545.6	(74)
North	0.9x	0.77	×	5.58	×	79.99	×	0.63] × [0.7] = [682	(74)
North	0.9x	0.77	×	2.73	×	79.99	×	0.63	x	0.7	=	400.4	(74)
North	0.9x	0.77	×	5.4	×	79.99	Χ.	0.63	×	0.7	=	132	(74)
North	0.9x	0.77	x	1.96	×	79.99	×	0.63	×	0.7	=	191.65	(74)
North	0.9x	0.77	×	4.08	×	79.99	×	0.63	×	0.7	=	99.73	(74)
North	0.9x	0.77	×	11.16	×	74.68	×	0.63	×	0.7	=	509.39	(74)
North	0.9x	0.77	×	5.58	×	74.68	×	0.63	×	0.7	=	636.74	(74)
North	0.9x	0.77	×	2.73	x	74.68	×	0.63	×	0.7	=	373.83	(74)
North	0.9x	0.77	×	5.4	x	74.68	×	0.63	×	0.7	=	123.24	(74)
North	0.9x	0.77	×	1.96	×	74.68	×	0.63	×	0.7	=	178.93	(74)
North	0.9x	0.77	×	4.08	×	74.68	×	0.63	×	0.7	=	93.11	(74)
North	0.9x	0.77	×	11.16	×	59.25	x	0.63	×	0.7	=	404.14	(74)
North	0.9×	0.77	×	5.58	×	59.25	×	0.63	×	0.7	=	505.17	(74)
North	0.9x	0.77	×	2.73	×	59.25	×	0.63	X	0.7	_ = _	296.58	(74)
North	0.9x	0.77	×	5.4	×	59.25	×	0.63	×	0.7	_ = _	97.77	(74)
North	0.9x	0.77	×	1.96	×	59.25	×	0.63	×	0.7	=	141.95	(74)
North	0.9x	0.77	×	4.08	×	59.25	×	0.63	×	0.7	_ = _	73.87	(74)
North	0.9x	0.77	×	11.16	×	41.52	×	0.63	x	0.7] = [283.2	(74)
North	0.9x	0.77	×	5.58	×	41.52	×	0.63	×	0.7	╡╹┝	354	(74)
North	0.9x	0.77	×	2.73	×	41.52	×	0.63	X	0.7	╡╹┝	207.83	(74)
North	0.9x	0.77	×	5.4	×	41.52	×	0.63	×	0.7	╡╹┝	68.52	(74)
North	0.9x	0.77	×	1.96	x	41.52	×	0.63	x	0.7	=	99.47	(74)

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	SAP	WorkSheet:	New	dwelling	design	stage
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North	0.9x	0.77	×	4.08	x	41.52	×	0.63] × [0.7	7 = Г	51.77	(74)
North	0.9x	0.77	×	11.16	x	24.19	ī × Ī	0.63	i × ľ	0.7	ī - Ē	165	(74)
North	0.9x	0.77	x	5.58	x	24.19	ī × Ī	0.63	i × ľ	0.7	i - F	206.25	(74)
North	0.9x	0.77	×	2.73	×	24.19] × [0.63	i × ľ	0.7	ī - Г	121.09	(74)
North	0.9x	0.77	x	5.4	x	24.19	×	0.63	İ×Ī	0.7] = [39.92	(74)
North	0.9x	0.77	×	1.96	×	24.19] × [0.63] × [0.7] <u>-</u> [57.96	(74)
North	0.9x	0.77	×	4.08	×	24.19] × [0.63] × [0.7] = [30.16	(74)
North	0.9x	0.77	×	11.16	×	13.12	×	0.63] × [0.7] = [89.48	(74)
North	0.9x	0.77	×	5.58	×	13.12] × [0.63] × [0.7] = [111.85	(74)
North	0.9x	0.77	×	2.73	x	13.12	×	0.63] × [0.7] = [65.67	(74)
North	0.9x	0.77	×	5.4	x	13.12	×	0.63	×	0.7	=	21.65	(74)
North	0.9x	0.77	x	1.96	×	13.12	×	0.63] × [0.7	=	31.43	(74)
North	0.9x	0.77	×	4.08	x	13.12	×	0.63	x	0.7	=	16.36	(74)
North	0.9x	0.77	x	11.16	x	8.86	×	0.63] × [0.7	=	60.47	(74)
North	0.9x	0.77	×	5.58	×	8.86	×	0.63	×	0.7	=	75.58	(74)
North	0.9x	0.77	×	2.73	×	8.86	×	0.63] × [0.7	-	44.38	(74)
North	0.9x	0.77	×	5.4	×	8.86	×	0.63	×	0.7	=	14.63	(74)
North	0.9x	0.77	×	1.96	×	8.86	×	0.63] × [0.7	=	21.24	(74)
North	0.9x	0.77	×	4.08	×	8.86	×	0.63	× [0.7	=	11.05	(74)
East	0.9x	0.54	×	4.79	×	19.64	×	0.63	×	0.7	=	20.16	(76)
East	0.9x	0.54	×	13.04	×	19.64	×	0.63	×	0.7	=	54.89	(76)
East	0.9x	0.54	×	16.83	x	19.64	×	0.63	×	0.7	=	70.84	(76)
East	0.9x	0.54	x	7.19	×	19.64	×	0.63	×	0.7	=	30.27	(76)
East	0.9x	0.77	×	3.38	×	19.64	×	0.63	×	0.7	=	20.29	(76)
East	0.9x	0.77	×	5.58	×	19.64	×	0.63	×	0.7	_ = _	200.96	(76)
East	0.9x	0.77	×	2.73	×	19.64	×	0.63	×	0.7	=	81.93	(76)
East	0.9x	0.77	×	3.9	x	19.64	×	0.63	×	0.7	=	46.82	(76)
East	0.9x	0.77	×	1.96	x	19.64	×	0.63	×	0.7	-	35.29	(76)
East	0.9x	0.54	×	4.79	×	38.42	×	0.63	×	0.7	_ = _	39.44	(76)
East	0.9x	0.54	×	13.04	×	38.42	×	0.63	×	0.7	=	107.38	(76)
East	0.9x	0.54	×	16.83	x	38.42	×	0.63	×	0.7	=	138.59	(76)
East	0.9x	0.54	×	7.19	×	38.42	×	0.63	×	0.7	╡╹└	59.21	(76)
East	0.9x	0.77	×	3.38	×	38.42	×	0.63	I × L	0.7	╡╹┝	39.69	(76)
East	0.9x	0.77	×	5.58	x	38.42	×	0.63	×	0.7	_ = _	393.12	(76)
East	0.9x	0.77	×	2.73	×	38.42	×	0.63	X	0.7	=	160.28	(76)
East	0.9x	0.77	×	3.9	x	38.42	×	0.63	×	0.7	╡╹┝	91.59	(76)
East	0.9x	0.77	×	1.96	×	38.42	×	0.63		0.7	╡╹┝	69.04	(76)
East	0.9x	0.54	×	4.79	×	63.27	×	0.63	×	0.7	╡╹┝	64.96	(76)
East	0.9x	0.54	×	13.04	x	63.27		0.63		0.7	╡╹┝	176.84	(76)
East	0.9x	0.54	×	16.83	×	63.27	×	0.63	×	0.7	╡╹┝	228.23	(76)
East	0.9x	0.54	X	7.19	x	63.27	x	0.63	x	0.7	=	97.5	(76)

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	SAP	WorkSheet:	New	dwelling	design	stage
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East	0.9x 0.77	, ,	C	3.38	×	63.27	×	0.63	x	0.7] = [65.36	(76)
East	0.9x 0.77	,		5.58	1 ×	63.27	x	0.63	x	0.7	1 = i	647.41	(76)
East	0.9x 0.77			2.73	×	63.27	×	0.63	x	0.7	i - i	263.95	(76)
East	0.9x 0.77	3	0	3.9	×	63.27	×	0.63	x	0.7	i = i	150.83	(76)
East	0.9x 0.77)	<	1.96	x	63.27	×	0.63	x	0.7	i = i	113.7	(76)
East	0.9x 0.54	,	5	4.79	×	92.28	×	0.63	x	0.7	i - i	94.74	(76)
East	0.9x 0.54	,		13.04	×	92.28	×	0.63	x	0.7	i - i	257.91	(76)
East	0.9x 0.54		0	16.83	×	92.28	×	0.63	x	0.7	i = i	332.86	(76)
East	0.9× 0.54	,	< 1	7.19	×	92.28	×	0.63	×	0.7] = [142.2	(76)
East	0.9x 0.77	,	¢	3.38	x	92.28	x	0.63	x	0.7] = [95.32	(76)
East	0.9x 0.77	,	6	5.58	x	92.28	×	0.63	x	0.7	=	944.2	(76)
East	0.9x 0.77	,	c 📃	2.73	×	92.28	×	0.63	x	0.7] = [384.96	(76)
East	0.9x 0.77		e 📃	3.9	x	92.28	x	0.63	x	0.7	=	219.98	(76)
East	0.9x 0.77		c i	1.96	x	92.28	×	0.63	x	0.7	=	165.83	(76)
East	0.9x 0.54)	(4.79	×	113.09	×	0.63	×	0.7	=	116.1	(76)
East	0.9x 0.54)	0	13.04	x	113.09	×	0.63	×	0.7] = [316.07	(76)
East	0.9x 0.54)	<	16.83	×	113.09	×	0.63	x	0.7	=	407.94	(76)
East	0.9x 0.54)		7.19	×	113.09	×	0.63	x	0.7] = [174.28	(76)
East	0.9x 0.77)	ç 📃	3.38	x	113.09	×	0.63	x	0.7	=	116.82	(76)
East	0.9x 0.77)	<	5.58	×	113.09	×	0.63	×	0.7	=	1157.16	(76)
East	0.9x 0.77)	¢.	2.73	x	113.09	×	0.63	x	0.7	=	471.78	(76)
East	0.9x 0.77)	c	3.9	x	113.09	×	0.63	×	0.7	=	269.59	(76)
East	0.9x 0.77	())	e	1.96	×	113.09	×	0.63	×	0.7	=	203.23	(76)
East	0.9x 0.54	,	<u> </u>	4.79	×	115.77	×	0.63	×	0.7	=	118.85	(76)
East	0.9x 0.54)	0	13.04	×	115.77	x	0.63	x	0.7	=	323.56	(76)
East	0.9x 0.54		c	16.83	×	115.77	×	0.63	x	0.7	=	417.6	(76)
East	0.9x 0.54)	C	7,19	x	115.77	x	0.63	x	0.7	=	178.4	(76)
East	0.9x 0.77		6	3.38	x	115.77	x	0.63	x	0.7	=	119.59	(76)
East	0.9x 0.77	6	6 .	5.58	×	115.77	×	0.63	×	0.7	=	1184.56	(76)
East	0.9x 0.77	2	G	2.73	×	115.77	×	0.63	x	0.7	=	482.95	(76)
East	0.9x 0.77		2	3.9	x	115.77	x	0.63	x	0.7	=	275.97	(76)
East	0.9x 0.77			1.96	×	115.77	×	0.63	×	0.7	=	208.04	(76)
East	0.9x 0.54)	0	4.79	x	110.22	×	0.63	x	0.7	=	113.15	(76)
East	0.9x 0.54)	()	13.04	x	110.22	×	0.63	x	0.7	=	308.04	(76)
East	0.9x 0.54)	9	16.83	×	110.22	×	0.63	x	0.7	=	397.57	(76)
East	0.9x 0.54)	C	7.19	x	110.22	x	0.63	x	0.7	=	169.85	(76)
East	0.9x 0.77)	<	3.38	×	110.22	×	0.63	×	0.7	=	113.85	(76)
East	0.9x 0.77)	¢	5.58	×	110.22	×	0.63	×	0.7	=	1127.74	(76)
East	0.9x 0.77)		2.73	x	110.22	×	0.63	x	0.7	=	459.79	(76)
East	0.9x 0.77)	e	3.9	×	110.22	×	0.63	x	0.7	-	262.74	(76)
East	0.9x 0.77)	0	1.96	x	110.22	×	0.63	x	0.7	=	198.06	(76)

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SAP	WorkSheet:	New	dwelling	design	stage

East	0.9x	0.54	×	4.79	x	94.68	×	0.63	x	0.7] = [97.2	(76)
East	0.9x	0.54	×	13.04	x	94.68	x	0.63	x	0.7	í - ľ	264.6	(76)
East	0.9x	0.54	×	16.83	x	94.68	×	0.63	x	0.7	1 - F	341.51	(76)
East	0.9x	0.54	×	7.19	×	94.68	×	0.63	x	0.7	ī - Ē	145.9	(76)
East	0.9x	0.77	×	3.38	x	94.68	×	0.63	x	0.7	ī - Ē	97.8	(76)
East	0.9x	0.77	×	5.58	×	94.68	×	0.63	x	0.7	1 - F	968.72	(76)
East	0.9x	0.77	×	2.73	×	94.68	×	0.63	x	0.7	<u>i - F</u>	394.95	(76)
East	0.9x	0.77	×	3.9	x	94.68	×	0.63	x	0.7	Ī = Ē	225.69	(76)
East	0.9x	0.77	×	1.96	×	94.68	×	0.63	x	0.7	Ī - [170.13	(76)
East	0.9x	0.54	×	4.79	x	73.59	x	0.63	x	0.7] = [75.55	(76)
East	0.9x	0.54	×	13.04	x	73.59	×	0.63	x	0.7] = [205.67	(76)
East	0.9x	0.54	×	16.83	x	73.59	×	0.63	x	0.7] = [265.44	(76)
East	0.9x	0.54	×	7.19	x	73.59	x	0.63	x	0.7] = [113.4	(76)
East	0.9x	0.77	x	3.38	x	73.59	×	0.63	x	0.7] = [76.02	(76)
East	0.9x	0.77	×	5.58	x	73.59	x	0.63	×	0.7	-	752.96	(76)
East	0.9x	0.77	×	2.73) x	73.59	×	0.63	×	0.7] = [306.99	(76)
East	0.9x	0.77	×	3.9	×	73.59	×	0.63	x	0.7] = [175.42	(76)
East	0.9x	0.77	×	1.96	x	73.59	×	0.63	x	0.7] = [132.24	(76)
East	0.9x	0.54	×	4.79	x	45.59	×	0.63	x	0.7] = [46.8	(76)
East	0.9x	0.54	×	13.04	×	45.59	×	0.63	×	0.7] = [127.41	(76)
East	0.9x	0.54	×	16.83	x	45.59	×	0.63	x	0.7] = [164.45	(76)
East	0.9x	0.54	×	7.19	x	45.59	×	0.63	×	0.7] = [70.25	(76)
East	0.9x	0.77	x	3.38	×	45.59	(x)	0.63	x	0.7] = [47.09	(76)
East	0.9x	0.77	×	5.58	×	45.59	×	0.63	×	0.7] = [466.47	(76)
East	0.9x	0.77	×	2.73	×	45.59	×	0.63	x	0.7] = [190.18	(76)
East	0.9x	0.77	×	3.9	×	45.59	×	0.63	x	0.7] = [108.67	(76)
East	0.9x	0.77	×	1.96	x	45.59	x	0.63	x	0.7	=	81.92	(76)
East	0.9x	0.54	×	4.79	x	24.49	x	0.63	x	0.7] = [25.14	(76)
East	0.9x	0.54	×	13.04	×	24.49	×	0.63	×	0.7	=	68.44	(76)
East	0.9x	0.54	×	16.83	×	24.49	×	0.63	×	0.7	=	88.33	(76)
East	0.9x	0.54	×	7.19	x	24.49	x	0.63	x	0.7	=	37.74	(76)
East	0.9x	0.77	×	3.38	×	24.49	×	0.63	x	0.7	=	25.3	(76)
East	0.9x	0.77	×	5.58	x	24.49	×	0.63	x	0.7] = [250.57	(76)
East	0.9x	0.77	×	2.73	x	24.49	×	0.63	x	0.7	=	102.16	(76)
East	0.9x	0.77	×	3.9	×	24.49	×	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	×	1.96	x	24.49	x	0.63	x	0.7	=	44.01	(76)
East	0.9x	0.54	×	4.79	×	16.15	×	0.63	×	0.7] = [16.58	(76)
East	0.9x	0.54	×	13.04	×	16.15	×	0.63	×	0.7] = [45.14	(76)
East	0.9x	0.54	×	16.83	×	16.15	×	0.63	×	0.7] = [58.26	(76)
East	0.9x	0.54	×	7.19	x	16.15	×	0.63	×	0.7] = [24.89	(76)
East	0.9x	0.77	×	3.38	x	16.15	x	0.63	x	0.7	=	16.68	(76)

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SAP	WorkSheet:	New	dwelling	design	stage

East	0.9x	0.77	×	5.58	x	16.15	×	0.63	×	0.7] = [165.26	(76)
East	0.9x	0.77	×	2.73	x	16.15	×	0.63	x	0.7	i - i	67.38	(76)
East	0.9x	0.77	×	3.9	x	16.15	×	0.63	x	0.7	i <u>-</u> i	38.5	(76)
East	0.9x	0.77	×	1.96	×	16.15	×	0.63	x	0.7	ī = Ē	29.02	(76)
South	0.9x	0.77	×	3.38	x	46.75	×	0.63	x	0.7	ī - Ē	386.35	(78)
South	0.9x	0.77	×	2.73	×	46.75	×	0.63	x	0.7	ī - Ē	351.06	(78)
South	0.9x	0.77	×	1.96	×	46.75	×	0.63	x	0.7	<u>i - i</u>	140.02	(78)
South	0.9x	0.77	×	3.38	×	76.57	×	0.63	x	0.7	ī - Ē	632.74	(78)
South	0.9x	0.77	×	2.73	×	76.57	×	0.63	x	0.7] = [574.94	(78)
South	0.9x	0.77	×	1.96	x	76.57	x	0.63	x	0.7] = [229.32	(78)
South	0.9x	0.77	×	3.38	×	97.53	×	0.63	x	0.7] = [806	(78)
South	0.9x	0.77	×	2.73	×	97.53	×	0.63	x	0.7] = [732.37	(78)
South	0.9x	0.77	×	1.96	x	97.53	x	0.63	x	0.7] = [292.11	(78)
South	0.9x	0.77	x	3.38	x	110.23	x	0.63	x	0.7] = [910.95	(78)
South	0.9x	0.77	×	2.73	×	110.23	×	0.63	×	0.7	=	827.74	(78)
South	0.9x	0.77	×	1.96	×	110.23	×	0.63	×	0.7	=	330.15	(78)
South	0.9x	0.77	×	3.38	×	114.87	×	0.63	x	0.7	=	949.27	(78)
South	0.9x	0.77	×	2.73	×	114.87	×	0.63	×	0.7] = [862.56	(78)
South	0.9x	0.77	×	1.96	×	114.87	×	0.63	x	0.7	=	344.04	(78)
South	0.9x	0.77	×	3.38	x	110.55	×	0.63	×	0.7] = [913.54	(78)
South	0.9x	0.77	×	2.73	×	110.55	×	0.63	x	0.7] = [830.09	(78)
South	0.9x	0.77	×	1.96	x	110.55	×	0.63	x	0.7	- [331.09	(78)
South	0.9x	0.77	x	3.38	×	108.01	(x)	0.63	x	0.7] = [892.59	(78)
South	0.9x	0.77	×	2.73	×	108.01	×	0.63	×	0.7] = [811.05	(78)
South	0.9x	0.77	×	1.96	×	108.01	×	0.63	x	0.7] = [323.5	(78)
South	0.9x	0.77	×	3.38	×	104.89	×	0.63	×	0.7	=	866.82	(78)
South	0.9x	0.77	×	2.73	x	104.89	x	0.63	x	0.7	=	787.64	(78)
South	0.9x	0.77	×	1.96	x	104.89	x	0.63	x	0.7	=	314.16	(78)
South	0.9x	0.77	×	3.38	×	101.89	×	0.63	x	0.7	=	841.96	(78)
South	0.9x	0.77	×	2.73	×	101.89	×	0.63	×	0.7	=	765.05	(78)
South	0.9x	0.77	×	1.96	x	101.89	x	0.63	x	0.7	=	305.15	(78)
South	0.9x	0.77	×	3.38	×	82.59	×	0.63	x	0.7	-	682.47	(78)
South	0.9x	0.77	×	2.73	×	82.59	×	0.63	x	0.7] = [620.13	(78)
South	0.9x	0.77	×	1.96	×	82.59	×	0.63	x	0.7	=	247.34	(78)
South	0.9x	0.77	×	3.38	×	55.42	×	0.63	x	0.7	=	457.95	(78)
South	0.9x	0.77	×	2.73	x	55.42	x	0.63	x	0.7	-	416.12	(78)
South	0.9x	0.77	×	1.96	×	55.42	×	0.63	×	0.7] = [165.97	(78)
South	0.9x	0.77	×	3.38	×	40.4	×	0.63	×	0.7	=	333.84	(78)
South	0.9x	0.77	×	2.73	×	40.4	×	0.63	×	0.7	_ = _	303.35	(78)
South	0.9x	0.77	×	1.96	×	40.4	×	0.63	×	0.7	_ = _	120.99	(78)
West	0.9x	0.77	×	5.58	x	19.64	×	0.63	x	0.7	=	133.97	(80)

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	SAP	WorkSheet:	New	dwelling	design	stage
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West	0.9x	0.77	×	3.38	×	19.64	×	0.63	×	0.7	=	40.58	(80)
West	0.9x	0.77	×	2.73	×	19.64	×	0.63	x	0.7	=	98.32	(80)
West	0.9x	0.77	×	1.96	×	19.64	×	0.63	×	0.7	=	35.29	(80)
West	0.9x	0.77	×	5.58	×	38.42	×	0.63	x	0.7	=	262.08	(80)
West	0.9x	0.77	×	3.38	x	38.42	×	0.63	x	0.7	=	79.37	(80)
West	0.9x	0.77	×	2.73	×	38.42	×	0.63	×	0.7	=	192.33	(80)
West	0.9x	0.77	×	1.96	×	38.42) × [0.63] × [0.7	=	69.04	(80)
West	0.9x	0.77	×	5.58	×	63.27	×	0.63	x	0.7	=	431.6	(80)
West	0.9×	0.77	×	3.38	×	63.27	×	0.63	×	0.7	=	130.72	(80)
West	0.9x	0.77	×	2.73	×	63.27	×	0.63	×	0.7	=	316.74	(80)
West	0.9x	0.77	×	1.96	×	63.27	×	0.63	x	0.7	=	113.7	(80)
West	0.9x	0.77	×	5.58	×	92.28	×	0.63] × [0.7	=	629.47	(80)
West	0.9x	0.77	×	3.38	x	92.28	×	0.63	×	0.7	=	190.65	(80)
West	0.9x	0.77	×	2.73	×	92.28	×	0.63	x	0.7	=	461.95	(80)
West	0.9x	0.77	×	1.96	×	92.28	×	0.63	×	0.7	=	165.83	(80)
West	0.9x	0.77	×	5.58	×	113.09	×	0.63	×	0.7	1	771.44	(80)
West	0.9x	0.77	×	3.38	×	113.09	×	0.63	×	0.7	=	233.64	(80)
West	0.9x	0.77	×	2.73	×	113.09	×	0.63	×	0.7] = [566.14	(80)
West	0.9x	0.77	×	1.96	×	113.09	×	0.63	x	0.7	=	203.23	(80)
West	0.9x	0.77	× [5.58	×	115.77	×	0.63	x	0.7] = [789.7	(80)
West	0.9x	0.77	×	3.38	×	115.77	×	0.63) × [0.7] = [239.18	(80)
West	0.9x	0.77	×	2.73	×	115.77	×	0.63	×	0.7	=	579.54	(80)
West	0.9x	0.77	×	1.96	×	115.77	X	0.63	×	0.7	=	208.04	(80)
West	0.9x	0.77	×	5.58	×	110.22	×	0.63	×	0.7	=	751.83	(80)
West	0.9x	0.77	×	3.38	×	110.22	×	0.63	x	0.7	=	227.7	(80)
West	0.9x	0.77	×	2.73	×	110.22	×	0.63	×	0.7	=	551.75	(80)
West	0.9x	0.77	×	1.96	x	110.22	x	0.63	×	0.7	=	198.06	(80)
West	0.9x	0.77	×	5.58	x	94.68	x	0.63	×	0.7	=	645.81	(80)
West	0.9x	0.77	×	3.38	×	94.68	×	0.63	×	0.7	=	195.59	(80)
West	0.9x	0.77	×	2.73	×	94.68	×	0.63] × [0.7	=	473.94	(80)
West	0.9x	0.77	×	1.96	×	94.68	x	0.63	x	0.7	=	170.13	(80)
West	0.9x	0.77	×	5.58	×	73.59	×	0.63	×	0.7	=	501.97	(80)
West	0.9x	0.77	×	3.38	×	73.59	×	0.63	x	0.7	=	152.03	(80)
West	0.9x	0.77	×	2.73	×	73.59	×	0.63	x	0.7	=	368.38	(80)
West	0.9x	0.77	×	1.96	×	73,59	×	0.63	× [0.7	=	132.24	(80)
West	0.9x	0.77	×	5.58	×	45.59	×	0.63	x	0.7] = [310.98	(80)
West	0.9x	0.77	×	3.38	×	45.59	×	0.63	x	0.7	=	94.18	(80)
West	0.9x	0.77	×	2.73	×	45.59	×	0.63	×	0.7	=	228.22	(80)
West	0.9x	0.77	×	1.96	×	45.59	×	0.63) x [0.7	=	81.92	(80)
West	0.9x	0.77	×	5.58	×	24.49	×	0.63	×	0.7	-	167.05	(80)
West	0.9x	0.77	×	3.38	x	24.49	x	0.63	x	0.7	=	50.59	(80)

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West	0.9x	0.77	×	2.7	73	x	24.49	x	0.63	x	0.7	=	124	.59	(80
West	0.9x	0.77	×	1.9	96	×	24.49	i . F	0.63	╡ょ╞	0.7	=	44		(80
West	0.9x	0.77	×	5.5		×	16.15	i . F	0.63	╡ _╺ ╞	0.7	-	-	0.17	(80
West	0.9x	0.77	×	3.3		×	16.15	╡╷╞	0.63	╡ _╸ ╞	0.7	=	-	37	(80
West	0.9x	0.77	×	2.7		x	16.15	×	0.63	╡ _╸ ╞	0.7	=		.85	(80
West	0.9x	0.77	×	1.0	_	×	16.15		0.63		0.7	=		02	(80
Roofligh	A STATE OF	1	×	46.		×	26	╡┈┝	0.63	╡┈┟	0.7	=		8.2	(82
Roofligh	-	1	x	46.		x	54	╡┊╞	0.63	╡ᆠ╞	0.7	=	-	.19	(82
Roofligh		1	= ^	46.		x	96	╡ᆠ┝	0.63	╡ᆠ╞	0.7	=		5.67	(82
Roofligh	and the second second	1		46.	_	×	150		0.63	╡ᆠ╞	0.7	=		8.85	(82
a 1880	nts 0.9x	1	×	46.		x	192	×	0.63		0.7	-	-	1.33	(82
Roofligh	NO-CONTRACTORY	1	×	46.		×	200		0.63	╡┊╞	0.7	=	-	8.47	(82
	nts 0.9x	1	- ×	46.		x	189		0.63	╡┈╞	0.7	=	-	6.15	(82
	nts 0.9x	1	x	46.		x	157		0.63		0.7	=	-	7.6	(82
Roofligh		1	×	46.		× -	115		0.63	╡ᆠ╞	0.7	=		5.12	(82
	nts 0.9x	1		46.		x	66	╡┊╞	0.63	╡ᆠ╞	0.7	-		3.89	(82
	nts 0.9x	1	×	46.	1277	×	33		0.63	╡ _╺ ╞	0.7	=	-	.95	(82
Roofligh		1	×	46.		×	21	╡┈┝	0.63	╡┈╞	0.7	=		.24	(82
Fotal g 84)m= [5924.26	nternal a	nd solar 10544.06	13372.46	= (73)m 15404.97	+ (83)ı 15520.	n , watts		2 10998.88	5402.78 8276.07		2086.89 5408.26	-		
Total g 84)m= 7. Me Temp	ains – i 5924.26 an inter erature	nternal a 8055.65 nal temp during h	nd solar 10544.06 erature eating p	(84)m = 13372.46 (heating eriods in	= (73)m 15404.97 season n the livi	+ (83)(15520.)) ng are	n , watts 36 14778.6: a from Ta	2 13078.2 able 9, T	2 10998.88]	1	(84
Total g 84)m= 7. Me Temp	ains – i 5924.26 an inter erature ation fac	nternal a 8055.65 nal temp during h ctor for ga	nd solar 10544.06 erature eating p ains for l	(84)m = 13372.46 (heating eriods in iving are	= (73)m 15404.97 I season I the livi ea, h1,m	+ (83)(15520.) ng are n (see	n , watts 36 14778.63 a from T <i>a</i> Table 9a)	2 13078.2 able 9, T	2 10998.88 h1 (°C)	8276.07	6189.28	5408.26]	1	(84
Fotal g 84)m= 7. Mea Temp Utilisa	ains – i 5924.26 an inter erature	nternal a 8055.65 nal temp during h	nd solar 10544.06 erature eating p	(84)m = 13372.46 (heating eriods in	= (73)m 15404.97 season n the livi	+ (83)(15520.)) ng are	n , watts 36 14778.63 a from T <i>a</i> Table 9a)	2 13078.2 able 9, T	2 10998.88 h1 (°C)]	1	(84
Total g 84)m= 7. Mea Temp Utilisa 86)m=	ains – i 5924.26 an inter erature ation fac Jan 1	nternal a 8055.65 nal temp during h ctor for ga Feb 1	nd solar 10544.06 erature eating p ains for I Mar 1	(84)m = 13372.46 (heating eriods in iving are Apr 0.99	= (73)m 15404.97 I season I the livi ea, h1,m May 0.97	+ (83)(15520.)) ing are 1 (see Jur 0.88	n , watts 36 14778.6; a from Ta Table 9a) 1 Jul 0.73	2 13078.2 able 9, T Aug 0.81	2 10998.88 h1 (°C) Sep 0.97	8276.07 Oct	6189.28	5408.26 Dec]	1	(84
Total g 84)m= 7. Mea Temp Utilisa 86)m= Mean	ains – i 5924.26 an inter erature ation fac Jan 1 interna	nternal a 8055.65 during h ctor for ga Feb 1	nd solar 10544.06 eating p ains for I Mar 1 ature in	(84)m = 13372.46 (heating eriods in iving are Apr 0.99	= (73)m 15404.97 1 season n the livi ea, h1,m May 0.97 ea T1 (f	+ (83) 15520.	n , watts 36 14778.63 a from Ta Table 9a) 1 Jul 0.73 teps 3 to	2 13078.2 able 9, T Aug 0.81	2 10998.88 h1 (°C) Sep 0.97 Dle 9c)	8276.07 Oct	6189.28	5408.26 Dec]	1	83) (85) (88)
Total g 84)m= [7. Mea Temp Utilisa 86)m= [Mean 87)m= [ains – i 5924.26 an inter erature ation fac Jan 1 interna 19.83	nternal a 8055.65 nal temp during h stor for ga Feb 1 I temper 19.94	nd solar 10544.06 eating p ains for I Mar 1 ature in 20.13	(84)m = 13372.46 (heating eriods in iving are Apr 0.99 living are 20.4	= (73)m 15404.97 season n the livi ea, h1,m May 0.97 ea T1 (fi 20.66	+ (83) (15520) ng are n (see Jur 0.88 ollow s 20.85	n , watts 36 14778.63 a from T <i>a</i> Table 9a) 1 Jul 0.73 teps 3 to 5 20.92	2 13078.2 able 9, T Aug 0.81 7 in Tat 20.9	2 10998.88 h1 (°C) Sep 0.97 ble 9c) 20.73	8276.07 Oct	6189.28 Nov 1	5408.26 Dec 1]	1	(84 (85
Fotal g 84)m= [7. Mea Temp Utilisa 86)m= [86)m= [87)m= [Temp	ains – i 5924.26 an inter erature ation fac Jan 1 interna 19.83 erature	nternal a 8055.65 nal temp during h ctor for g: Feb 1 I temper 19.94 during h	nd solar 10544.06 eating p ains for I Mar 1 ature in 20.13 eating p	(84)m = 13372.46 (heating eriods in iving are Apr 0.99 living an 20.4 eriods in	= (73)m 15404.97 1 season n the livi ea, h1,m May 0.97 ea T1 (fi 20.66 n rest of	+ (83) (15520) ng are 1 (see Jur 0.88 ollow s 20.85 dwellii	n , watts 36 14778.6: 7 a from Ta 7 able 9a) 1 Jul 0.73 teps 3 to 5 20.92 ng from T	2 13078.2 able 9, T Aug 0.81 7 in Tat 20.9	2 10998.88 h1 (°C) Sep 0.97 ble 9c) 20.73 Th2 (°C)	8276.07 Oct 1	6189.28 Nov 1 20.06	5408.26 Dec 1]	1	(8) (8) (8) (8)
Fotal g. 84)m= 7. Mean Temp Utilisa 86)m= Mean 87)m= Temp 88)m=	ains – i 5924.26 an inter erature ation fac Jan 1 interna 19.83 erature 20.02	nternal a 8055.65 nal temp during h tor for g Feb 1 I temper 19.94 during h 20.02	nd solar 10544.06 eating p ains for I Mar 1 ature in 20.13 eating p 20.02	(84)m = 13372.46 (heating eriods in iving are 0.99 living an 20.4 eriods in 20.03	 (73)m 15404.97 Season the livi ea, h1,m May 0.97 ea T1 (f 20.66 n rest of 20.03 	+ (83)1 15520. ng are 1 (see 0.88 0llow s 20.85 dwellii 20.04	n , watts a from T <i>a</i> Table 9a) Jul 0.73 teps 3 to 5 20.92 ng from T 4 20.04	2 13078.2 able 9, T Aug 0.81 7 in Tab 20.9 Cable 9, 20.04	2 10998.88 h1 (°C) Sep 0.97 ble 9c) 20.73	8276.07 Oct	6189.28 Nov 1	5408.26 Dec 1]	1	(84 (85 (86) (87
Fotal g 84)m= 7. Mea Temp Utilisa 86)m= Mean 87)m= Temp Utilisa Utilisa Utilisa Utilisa	ains – i 5924.26 an inter erature ation fac Jan 1 interna 19.83 erature 20.02 ation fac	nternal a 8055.65 nal temp during h tor for g: Feb 1 I temper 19.94 during h 20.02 tor for g	nd solar 10544.06 eating p ains for I Mar 1 ature in 20.13 eating p 20.02 ains for I	(84)m = 13372.46 (heating eriods in iving are 0.99 living are 20.4 eriods in 20.03 rest of d	 (73)m 15404.97 Season season the livi ea, h1,m May 0.97 ea T1 (fi 20.66 n rest of 20.03 welling, 	+ (83)1 15520. ing are 1 (see 0.88 ollow s 20.85 dwellin 20.04 h2,m (n , watts 36 14778.6 a from Ta Table 9a) Jul 0.73 teps 3 to 20.92 ng from T 20.04 see Table	2 13078.2 able 9, T Aug 0.81 7 in Tat 20.9 able 9, 20.04 e 9a)	2 10998.88 h1 (°C) Sep 0.97 ble 9c) 20.73 Th2 (°C) 20.03	0ct 1 20.39	6189.28 Nov 1 20.06 20.03	5408.26 Dec 1 19.81 20.02]	1	 (8) (8) (8) (8) (8) (8)
Fotal g 84)m= 7. Mea Temp Utilisa 86)m= Mean 87)m= Temp 88)m= Utilisa 88)m= Utilisa	ains – i 5924.26 an inter erature ation fac Jan 1 interna 19.83 erature 20.02 ation fac 1	nternal a 8055.85 nal temp during h tor for ga Feb 1 temper 19.94 during h 20.02 tor for ga 1	nd solar 10544.06 eating p ains for I Mar 1 ature in 20.13 eating p 20.02 ains for I 1	(84)m = 13372.46 (heating eriods in iving are 0.99 living an 20.4 eriods in 20.03 rest of d 0.99	 (73)m 15404.97 season n the livi ea, h1,m May 0.97 ea T1 (fr 20.66 n rest of 20.03 welling, 0.95 	+ (83)n 15520. ng are (see Jun 0.88 0llow s 20.85 dwellin 20.04 h2,m (0.81	n , watts a from Ta Table 9a) Jul 0.73 teps 3 to 5 20.92 ng from T 20.04 (see Table 0.6	2 13078.2 able 9, T Aug 0.81 7 in Tab 20.9 able 9, ' 20.04 e 9a) 0.7	2 10998.88 h1 (°C) Sep 0.97 ble 9c) 20.73 Th2 (°C) 20.03	8276.07 Oct 1 20.39 20.03	6189.28 Nov 1 20.06	5408.26 Dec 1]	1	 (8) (8) (8) (8) (8) (8)
Total g 84)m= 7. Me: Temp Utilisa 86)m= Mean 87)m= Temp Utilisa 88)m= Utilisa 88)m= Utilisa 89)m= Mean	ains – i 5924.26 an inter erature ation fac Jan 1 interna 19.83 erature 20.02 ation fac 1 interna	nternal a 8055.65 nal temp during h tor for ga Feb 1 I temper 19.94 during h 20.02 tor for ga 1 I temper	nd solar 10544.06 eating p ains for I Mar 1 ature in 20.13 eating p 20.02 ains for r 1 ature in	(84)m = 13372.46 (heating eriods in iving are 0.99 living an 20.4 eriods in 20.03 rest of d 0.99 the rest	 (73)m (73)m (15404.97) (15	+ (83) 15520.	n , watts 36 14778.6 a from Ta Table 9a) 1 Jul 0.73 teps 3 to 5 20.92 ng from T 1 20.04 see Tablo 0.6 (follow st	2 13078.2 able 9, T Aug 0.81 7 in Tab 20.9 able 9, ' 20.04 e 9a) 0.7 teps 3 to	2 10998.88 h1 (°C) Sep 0.97 ble 9c) 20.73 Th2 (°C) 20.03 0.95 0 7 in Tab	8276.07 Oct 1 20.39 20.03 1 le 9c)	6189.28 Nov 1 20.06 20.03	5408.26 Dec 1 19.81 20.02]	1	 (82) (85) (87) (87) (88) (88) (88)
Fotal g 84)m= 7. Mea Temp Utilisa 86)m= Mean 87)m= Temp Utilisa 88)m= Utilisa 88)m= Utilisa 88)m= Utilisa 89)m= Mean	ains – i 5924.26 an inter erature ation fac Jan 1 interna 19.83 erature 20.02 ation fac 1	nternal a 8055.85 nal temp during h tor for ga Feb 1 temper 19.94 during h 20.02 tor for ga 1	nd solar 10544.06 eating p ains for I Mar 1 ature in 20.13 eating p 20.02 ains for I 1	(84)m = 13372.46 (heating eriods in iving are 0.99 living an 20.4 eriods in 20.03 rest of d 0.99	 (73)m 15404.97 season n the livi ea, h1,m May 0.97 ea T1 (fr 20.66 n rest of 20.03 welling, 0.95 	+ (83)n 15520. ng are (see Jun 0.88 0llow s 20.85 dwellin 20.04 h2,m (0.81	n , watts 36 14778.6 a from Ta Table 9a) 1 Jul 0.73 teps 3 to 5 20.92 ng from T 1 20.04 see Tablo 0.6 (follow st	2 13078.2 able 9, T Aug 0.81 7 in Tab 20.9 able 9, ' 20.04 e 9a) 0.7	2 10998.88 h1 (°C) Sep 0.97 ble 9c) 20.73 Th2 (°C) 20.03 0.95 7 in Tab 19.74	8276.07 Oct 1 20.39 20.03 1 le 9c) 19.25	6189.28 Nov 1 20.06 20.03 1 18.76	5408.26 Dec 1 19.81 20.02 1 18.4			 (8) (8) (8) (8) (8) (8) (8) (8) (9)
Fotal g 84)m= 7. Mea Temp Utilisa 86)m= Mean 87)m= Temp Utilisa 88)m= Utilisa 88)m= Utilisa 88)m= Utilisa 89)m= Mean	ains – i 5924.26 an inter erature ation fac Jan 1 interna 19.83 erature 20.02 ation fac 1 interna	nternal a 8055.65 nal temp during h tor for ga Feb 1 I temper 19.94 during h 20.02 tor for ga 1 I temper	nd solar 10544.06 eating p ains for I Mar 1 ature in 20.13 eating p 20.02 ains for r 1 ature in	(84)m = 13372.46 (heating eriods in iving are 0.99 living an 20.4 eriods in 20.03 rest of d 0.99 the rest	 (73)m (73)m (15404.97) (15	+ (83) 15520.	n , watts 36 14778.6 a from Ta Table 9a) 1 Jul 0.73 teps 3 to 5 20.92 ng from T 1 20.04 see Tablo 0.6 (follow st	2 13078.2 able 9, T Aug 0.81 7 in Tab 20.9 able 9, ' 20.04 e 9a) 0.7 teps 3 to	2 10998.88 h1 (°C) Sep 0.97 ble 9c) 20.73 Th2 (°C) 20.03 0.95 7 in Tab 19.74	8276.07 Oct 1 20.39 20.03 1 le 9c) 19.25	6189.28 Nov 1 20.06 20.03	5408.26 Dec 1 19.81 20.02 1 18.4		1	 (8) (8) (8) (8) (8) (8) (8) (8) (9)
Fotal g 84)m= 7. Mea Temp Utilisa 86)m= Mean 87)m= Temp Utilisa 88)m= Utilisa 88)m= Utilisa 89)m= Mean 90)m= Mean	ains – i 5924.26 an inter erature ation fac Jan 1 interna 19.83 erature 20.02 ation fac 1 interna 18.41 interna	nternal a 8055.65 nal temp during h tor for ga Feb 1 I temper 19.94 during h 20.02 tor for ga tor for ga 1 I temper 18.57	nd solar 10544.06 eating p ains for I Mar 1 ature in 20.13 eating p 20.02 ains for r 1 ature in 1 8.86	(84)m = 13372.46 (heating eriods in iving are 0.99 living an 20.4 eriods in 20.03 rest of d 0.99 the rest 19.26 r the wh	 (73)m (73)m (15404.97) (15	+ (83) 15520. 100 100 100 100 100 100 100 1	n , watts 36 14778.62 a from Ta Table 9a) 1 Jul 0.73 teps 3 to 5 20.92 ng from T 20.04 see Table 0.6 (follow st 19.95 fLA × T1	2 13078.2 able 9, T Aug 0.81 7 in Tab 20.9 able 9, ' 20.04 e 9a) 0.7 teps 3 to 19.94	2 10998.88 h1 (°C) Sep 0.97 ble 9c) 20.73 Th2 (°C) 20.03 0.95 7 in Tab 19.74	8276.07 Oct 1 20.39 20.03 1 10.03 1 19.25 1LA = Livin	6189.28 Nov 1 20.06 20.03 1 18.76 ng area + (r	5408.26 Dec 1 19.81 20.02 1 18.4 4) =			 48) 38) 78) 38) 38) 38) 38) 40) 40) 40)
Fotal g 84)m= 7. Mean Temp Utilisa 86)m= Mean 87)m= Temp Utilisa 88)m= Utilisa 89)m= Mean 90)m= Mean 92)m=	ains – i 5924.26 an inter erature ation fac Jan 1 interna 19.83 erature 20.02 ation fac 1 interna 18.41 interna 18.48	nternal a 8055.65 nal temp during h tor for g: Feb 1 I temper: 19.94 during h 20.02 tor for g: 1 I temper: 18.57 I temper: 18.64	nd solar 10544.06 eating p ains for I Mar 1 ature in 20.13 eating p 20.02 ains for I 1 ature in 1 18.86 ature (fo 18.92	(84)m = 13372.46 (heating eriods in iving are 0.99 living are 20.4 eriods in 20.03 rest of d 0.99 the rest 19.26 r the wh 19.32	 (73)m (73)m (15404.97) (15	+ (83) 15520. 100 100 100 100 100 100 100 1	n , watts 36 14778.63 a from Ta Table 9a) 1 Jul 0.73 teps 3 to 6 20.92 ng from Ta 20.04 see Table 0.6 (follow st 19.95 fLA × T1 20	2 13078.2 able 9, T Aug 0.81 7 in Tab 20.9 able 9, 7 20.04 e 9a) 0.7 teps 3 to 19.94 1 + (1 – 19.99	2 10998.88 h1 (°C) Sep 0.97 ble 9c) 20.73 Th2 (°C) 20.03 Th2 (°C) 20.03 0.95 7 in Tab 19.74 fLA) × T2 19.78	8276.07 Oct 1 20.39 20.03 1 le 9c) 19.25 fLA = Livin 19.3	6189.28 Nov 1 20.06 20.03 1 18.76	5408.26 Dec 1 19.81 20.02 1 18.4			 48) 38) 78) 38) 38) 38) 38) 40) 40) 40)
Total g 84)m= 7. Mean Temp Utilisa 86)m= Mean 87)m= Temp Utilisa 88)m= Utilisa 89)m= Utilisa 90)m= Mean 90)m= Mean 92)m= Apply	ains – i 5924.26 an inter erature ation fac Jan 1 interna 19.83 erature 20.02 ation fac 1 interna 18.41 interna 18.48 adjustr	nternal a 8055.65 nal temp during h tor for g Feb 1 I temper 19.94 during h 20.02 tor for g tor for g 1 I temper 18.57 I temper 18.64 nent to ti	nd solar 10544.06 eating p ains for I Mar 1 ature in 20.13 eating p 20.02 ains for I 1 ature in 1 18.86 ature (fo 18.92 ne mean	(84)m = 13372.46 (heating eriods in iving are 0.99 living are 20.4 eriods in 20.03 rest of d 0.99 the rest 19.26 r the wh 19.32 interna	 (73)m (73)m (730m) /ul>	+ (83) 15520. 15520. 15520. 15520. 15520. 15520. 15520. 15520. 15520. 15520. 15520. 10.88 20.85 20.95 20.9	n , watts 36 14778.63 a from Ta Table 9a) 1 0.73 teps 3 to 5 20.92 ng from Ta 20.04 see Table 0.6 (follow st 19.95 : fLA × T1 : 20 : 20 : 20	2 13078.2 able 9, T Aug 0.81 7 in Tab 20.9 20.04 e 9a) 0.7 teps 3 to 19.94 1 + (1 – 19.99 e 4e, wh	2 10998.88 h1 (°C) Sep 0.97 ble 9c) 20.73 Th2 (°C) 20.03 Th2 (°C)	8276.07 Oct 1 20.39 20.03 1 le 9c) 19.25 fLA = Livin 19.3 opriate	6189.28 Nov 1 20.06 20.03 1 18.76 ng area + (r 18.83	5408.26 Dec 1 19.81 20.02 1 18.4 4) = 18.47			(63 (84 (84 (85 (85 (87 (87 (87 (87 (87 (87 (87 (87) (87) (
Total g (84)m= 7. Mer Temp Utilisa (86)m= (86)m= (86)m= (86)m= (87)m= Temp (88)m= Utilisa (89)m= Utilisa (89)m= Mean (90)m= Mean (92)m= Apply (93)m=	ains – i 5924.26 an inter erature ation fac Jan 1 interna 19.83 erature 20.02 ation fac 1 interna 18.41 interna 18.48 adjustr 18.48	nternal a 8055.65 nal temp during h tor for g: Feb 1 I temper 19.94 during h 20.02 tor for g: 1 temper 18.57 I temper 18.64 nent to tl 18.64	nd solar 10544.06 eating p ains for I Mar 1 ature in 20.13 eating p 20.02 ains for 1 ature in 18.86 ature (fo 18.92 ne mean 18.92	(84)m = 13372.46 (heating eriods in iving are 0.99 living are 20.4 eriods in 20.03 rest of d 0.99 the rest 19.26 r the wh 19.32	 (73)m (73)m (15404.97) (15	+ (83) 15520. 100 100 100 100 100 100 100 1	n , watts 36 14778.63 a from Ta Table 9a) 1 0.73 teps 3 to 5 20.92 ng from Ta 20.04 see Table 0.6 (follow st 19.95 : fLA × T1 : 20 : 20 : 20	2 13078.2 able 9, T Aug 0.81 7 in Tab 20.9 able 9, 7 20.04 e 9a) 0.7 teps 3 to 19.94 1 + (1 – 19.99	2 10998.88 h1 (°C) Sep 0.97 ble 9c) 20.73 Th2 (°C) 20.03 Th2 (°C) 20.03 0.95 7 in Tab 19.74 fLA) × T2 19.78	8276.07 Oct 1 20.39 20.03 1 le 9c) 19.25 fLA = Livin 19.3	6189.28 Nov 1 20.06 20.03 1 18.76 ng area + (r	5408.26 Dec 1 19.81 20.02 1 18.4 4) =			 48) 38) 78) 38) 38) 38) 38) 40) 40) 40)
Total g (84)m= 7. Mer Temp Utilisa (86)m= (86)m= (86)m= (86)m= (87)m= Temp (88)m= Utilisa (89)m= Utilisa (89)m= Mean (90)m= Mean (92)m= Apply (93)m=	ains – i 5924.26 an inter erature ation fac Jan 1 interna 19.83 erature 20.02 ation fac 1 interna 18.41 interna 18.48 adjustr 18.48	nternal a 8055.65 nal temp during h tor for g: Feb 1 I temper 19.94 during h 20.02 tor for g: 1 temper 18.57 I temper 18.64 nent to tl 18.64	nd solar 10544.06 eating p ains for I Mar 1 ature in 20.13 eating p 20.02 ains for 1 ature in 18.86 ature (fo 18.92 ne mean 18.92	(84)m = 13372.46 (heating eriods in iving are 0.99 living are 20.4 eriods in 20.03 rest of d 0.99 the rest 19.26 r the wh 19.32 interna	 (73)m (73)m (730m) /ul>	+ (83) 15520. 15520. 15520. 15520. 15520. 15520. 15520. 15520. 15520. 15520. 15520. 10.88 20.85 20.95 20.9	n , watts 36 14778.63 a from Ta Table 9a) 1 0.73 teps 3 to 5 20.92 ng from Ta 20.04 see Table 0.6 (follow st 19.95 : fLA × T1 : 20 : 20 : 20	2 13078.2 able 9, T Aug 0.81 7 in Tab 20.9 20.04 e 9a) 0.7 teps 3 to 19.94 1 + (1 – 19.99 e 4e, wh	2 10998.88 h1 (°C) Sep 0.97 ble 9c) 20.73 Th2 (°C) 20.03 Th2 (°C)	8276.07 Oct 1 20.39 20.03 1 le 9c) 19.25 fLA = Livin 19.3 opriate	6189.28 Nov 1 20.06 20.03 1 18.76 ng area + (r 18.83	5408.26 Dec 1 19.81 20.02 1 18.4 4) = 18.47			 (8) (8) (8) (8) (8) (8) (8) (9) (91) (91)
Total g 84)m= 7. Mea Temp Utilisa 86)m= Mean 87)m= Temp Utilisa 88)m= Utilisa 89)m= Utilisa 90)m= Mean 90)m= Mean 92)m= Apply 93)m= 8. Spa Set Ti	ains – i 5924.26 an inter erature ation fac Jan 1 interna 19.83 erature 20.02 ation fac 1 interna 18.41 interna 18.48 adjustr 18.48 acc hea i to the	nternal a 8055.65 nal temp during h tor for g: Feb 1 I temper 19.94 during h 20.02 tor for g: 1 I temper 18.57 I temper 18.64 nent to ti 18.64 ting requ	nd solar 10544.06 eating p ains for I Mar 1 ature in 20.13 eating p 20.02 ains for 1 20.02 ains for 1 ature in 18.86 ature (fo 18.92 iirement ernal ter	(84)m = 13372.46 (heating eriods in iving are 0.99 living are 20.4 eriods in 20.4 eriods in 20.3 rest of d 0.99 the rest 19.26 r the wh 19.32 interna 19.32 mperatum	 (73)m (73)m (15404.97) (15	+ (83)1 15520. 15520. ng are 15520. 100 100 100 100 100 100 100 1	n watts a from Ta Table 9a) Jul 0.73 0.73 teps 3 to 20.92 ng from Ta 20.04 see Table 0.6 (follow st 19.95 cfLA × T1 20 a 20	2 13078.2 able 9, T Aug 0.81 7 in Tat 20.9 able 9, 1 20.04 e 9a) 0.7 teps 3 to 19.94 1 + (1 – 1 19.99 e 4e, wh 19.99	2 10998.88 h1 (°C) Sep 0.97 ble 9c) 20.73 Th2 (°C) 20.03 Th2 (°C)	8276.07 Oct 1 20.39 20.03 1 19.25 1LA = Livit 19.3 opriate 19.3	6189.28 Nov 1 20.06 20.03 1 18.76 ng area + (* 18.83	5408.26 Dec 1 19.81 20.02 1 18.4 4) = 18.47 18.47			 (8) (8) (8) (8) (8) (9) (9) (9) (9) (9) (9)

Utilisation factor for gains, hm:					
(94)m= 1 1 1 0.99 0.95 0.8	0.6 0.69 0.94	1	1 1		(94)
Useful gains, hmGm , W = (94)m x (84)m	den fan		-10		
(95)m= 5924.02 8053.79 10528.89 13237.59 14566.72 12485.01 88	04.95 9009.13 10387.	53 8255.44 61	88.45 5408.1	3	(95)
Monthly average external temperature from Table 8				_	
(96)m= 4.3 4.9 6.5 8.9 11.7 14.6 1	6.6 16.4 14.1	10.6	7.1 4.2		(96)
Heat loss rate for mean internal temperature, Lm , W=[(3	9)m x [(93)m– (96)	m]			
(97)m= 38701.08 37421.82 33769.43 28065.16 21479.11 14227.23 90	69.88 9558.19 15214.	89 23405.81 316	47.12 38641.0	03	(97)
Space heating requirement for each month, kWh/month =	0.024 x [(97)m – (-	
(98)m= 24386.14 19735.32 17290.96 10675.85 5142.82 0	0 0 0	11271.88 183	30.24 24725.2	28	
	Total per ye	ar (kWh/year) =	Sum(98)1.5.9.12	= 131558.49	(98)
Space heating requirement in kWh/m²/year				52.09	(99)
8c. Space cooling requirement					_
Calculated for June, July and August. See Table 10b					
	Jul Aug Se	p Oct	Nov Dec	5	
Heat loss rate Lm (calculated using 25°C internal temperative			om Table 1	0)	
	47.45 20251.45 0	0	0 0	Ń.	(100)
Utilisation factor for loss hm			-	_	
(101)m= 0 0 0 0 0.65 0	0.76 0.68 0	0	0 0	7	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m				-	
(102)m= 0 0 0 0 0 16427.14 149	19.22 13710.78 0	0	0 0		(102)
Gains (solar gains calculated for applicable weather region	on, see Table 10)	10 20			
(103)m= 0 0 0 0 0 17208.77 163	88.15 14477.1 0	0	0 0		(103)
Space cooling requirement for month, whole dwelling, con	ntinuous (kWh) = 0	0.024 x [(103)	n – (102)m] x (41)m	
set (104)m to zero if (104)m < 3 × (98)m					
(104)m= 0 0 0 0 0 562.77 10	92.88 0 0	0	0 0		-
		tal = Sum(1.04	125610	1655.65	(104)
Cooled fraction	t C	= cooled are	a ÷ (4) =	0.59	(105)
Intermittency factor (Table 10b) (106)m= 0 0 0 0 0 0.25 0	0.25 0.25 0	0	0 0	7	
	020002 10202020 111000			-	(100)
Space cooling requirement for month = $(104)m \times (105) \times (105)$		tal = Sum(1,0,	4) =	0	(106)
	32.27 0 0	0	0 0	7	
		tal = Sum(1,0,	33. S.	245.83	(107)
Cases cooling convictment in hMM/m2/veer)		
Space cooling requirement in kWh/m²/year	A DECEMBER OF THE OWNER OWNER OF THE OWNER OWN)7) ÷ (4) =		0.1	(108)
9a. Energy requirements – Individual heating systems inclu	uding micro-CHP)				
Space heating: Fraction of space heat from secondary/supplementary sy	stem			0.1	(201)
Fraction of space heat from main system(s)	(202) = 1 - (201)	-		0.9	(202)
Fraction of main heating from main system 2				0.1	(203)
Fraction of total heating from main system 1	(204) = (202) × [1	- (203)] =		0.81	(204)
Fraction of total heating from main system 2	(205) = (202) × (2	(03) =		0.09	(205)
Efficiency of main space heating system 1		8		319.7	(206)
Emolency of main space heating system i				319.7	(200)

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Effici	ency of	main sp	ace heat	ting syste	em 2							Γ	93.3	(207)
Effici	ency of	seconda	iry/suppl	ementar	y heatin	g systen	n, %					Ī	80	(208)
Cooli	ing Syst	em Ener	gy Effici	ency Rat	tio							Ī	6.75	(209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Spac	<u> </u>	T	· · · ·	calculate	-	<u> </u>								
	24386.14	19735.32	17290.96	10675.85	5142.82	0	0	0	0	11271.88	18330.24	24725.28		
(211)r	n = {[(98	3)m x (20	04)]}x1	100 ÷ (20)6)									(211)
	6178.53	5000.19	4380.88	2704.86	1303	0	0	0	0	2855.87	4644.2	6264.46		
								Tota	al (kWh/ye	ar) =Sum(211) _{1.510.12}	Ē	33331.99	(211)
(213)	n =(98)r	n x (203)) x 100 ÷	- (207)										
(213)m=	2352.36	1903.73	1667.94	1029.82	496.09	0	0	0	0		1768.19			_
								Tota	il (kWh/ye	ar) =Sum()	213),	-	12690.53	(213)
Spac	e heatir	ig fuel (s	econdar	y), kWh/	month									
= {[(98	3)m x (2	01)]}x1	00 ÷ (20	(8)										
(215)m	3048.27	2466.91	2161.37	1334.48	642.85	0	0	0	0	100000000000000000000000000000000000000	2291.28	100000000		_
								Tota	l (kWh/ye	ar) =Sum(21 5)_{15.1015}	-	16444.81	(215)
Water	heating	g												
Outpu	10000000000000000000000000000000000000			ulated a						1	02010	<u> </u>		
	424.14	374.82	395.95	358.14	353.28	318.99	309.52	335.28	333.32	371.21	388.5	415.01		-
Efficie	-	ater hea	ater							511010701			79.6	(216)
(217)m		88.23	87.9	87.12	85.33	79.6	79.6	79.6	79.6	87.16	88.04	88.43		(217)
		heating.												
	479.93	m x 100 424.8	450.43	411.08	413.99	400.74	388.85	421.21	418.74	425.89	441.25	469.31		
								Tota	al = Sum(2	(19a) ₁₁₂ =			5146.22	(219)
Space	e coolin	g fuel, k	Wh/mo	nth.								J.	25.00800155	_
		')m+ (20		00003945		_								
(221)m=	0	0	0	0	0	12.38	24.04	0	0	0	0	0		
								Tota	al = Sum(2	21) _{8.8} =			36.42	(221)
Annua	al totals									k	Wh/yea		kWh/yea	r
Space	heating	fuel use	ed, main	system	1							Γ	33331.99	
Space	heating	fuel use	ed, main	system	2							Ī	12690.53	Ē
Space	heating	fuel use	ed, seco	ndary								Ī	16444.81	Ē
Water	heating	fuel use	ed									Ĩ	5146.22	Ī
Space	cooling	fuel use	ed									Ī	36.42	Ī
Electri	icity for (pumps, f	ans and	electric	keep-ho	t								
centr	al heatii	ng pump	:									60		(230c)
boile	r with a	fan-assis	sted flue									45		(230e)
Total e	electricit	y for the	above,	kWh/yea	r			sum	of (230a)	(230g) =		را	105	(231)
Electri	icity for I	ighting		78								ř	2871.02	(232)
	- C	erated b	y PVs									ĥ	-3346.17	(233)
1000000780		~~	·									L	CONTRACTOR OF THE	

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10a. Fuel costs - individual heating sys	stems:		
	Fuel kWh/year	Fuel Price (Table 12)	F uel Cost £/year
Space heating - main system 1	(211) x	13.19 × 0.01 =	4396.49 (240)
Space heating - main system 2	(213) x	3.48 × 0.01 =	441.63 (241)
Space heating - secondary	(215) x	3.48 × 0.01 =	572.28 (242)
Water heating cost (other fuel)	(219)	3.48 × 0.01 =	179.09 (247)
Space cooling	(221)	13.19 × 0.01 =	4.8 (248)
Pumps, fans and electric keep-hot	(231)	13.19 × 0.01 =	13.85 (249)
(if off-peak tariff, list each of (230a) to (2 Energy for lighting	230g) separately as applicable and (232)	d apply fuel price according to 13.19 × 0.01 =	
Additional standing charges (Table 12)			120 (251)
	one of (233) to (235) x)	13.19 × 0.01 =	-441.36 (252)
Appendix Q items: repeat lines (253) ar Total energy cost	nd (254) as needed (245)(247) + (250)(254) =		5665.47 (255)
11a. SAP rating - individual heating sy			5665.47 (255)
a an in stration the cost form	acon na		r
Energy cost deflator (Table 12)	[(255) x (256)] + [(4) + 45.0] =		0.42 (256)
Energy cost factor (ECF) SAP rating (Section 12)	[(200) x (200)] · [(4) · 40.0] -		0.93 (257) 87.09 (258)
12a, CO2 emissions – Individual heati	ng systems including micro-CHP		07.03
		Emission feator	Emissions
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.519 =	17299.3 (261)
Space heating (main system 2)	(213) x	0.216 =	2741.15 (262)
Space heating (secondary)	(215) x	0.216 =	3552.08 (263)
Water heating	(219) x	0.216 =	1111.58 (264)
Space and water heating	(261) + (262) + (263) + (26	64) =	24704.12 (265)
Space cooling	(221) x	0.519 =	18.9 (266)
Electricity for pumps, fans and electric	(231) x	0.519 =	54.5 (267)
Electricity for lighting	(232) x	0.519 =	1490.06 (268)
Energy saving/generation technologies Item 1		0.519 =	-1736.66 (269)
Total CO2, kg/year		sum of (265)(271) =	24530.91 (272)
CO2 emissions per m ²		(272) + (4) =	9.71 (273)
El rating (section 14)			87 (274)
13a. Primary Energy			

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	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	3.07	=	102329.21	(261)
Space heating (main system 2)	(213) x	1.22	=	15482.45	(262)
Space heating (secondary)	(215) x	1.22	=	20062.67	(263)
Energy for water heating	(219) x	1.22	=	6278.39	(264)
Space and water heating	(261) + (262) + (263) +	(264) =		144152.72	(265)
Space cooling	(221) x	3.07	=	111.81	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07		322.35	(267)
Electricity for lighting	(232) x	0	=	8814.02	(268)
Energy saving/generation technologies Item 1		3.07	=	-10272.74	(269)
'Total Primary Energy		sum of (265)(271) =		143128.16	(272)
Primary energy kWh/m²/year		(272) + (4) =		56.67	(273)

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APPENDIX (iii)

SAP L1A 2013/16 REGULATION COMPLIANCE REPORT

(SAP Checklist)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.7 Printed on 05 October 2020 at 16:29:29

ssessed By:	Ondrej Gajdos (STR0006629)	Building Type:	Detached House
Dwelling Details:		2000 CE- CATORINO #		
	DESIGN STAGE		Total Floor Area: 2	2525.6m ²
ite Reference :	28AR		Plot Reference:	28, Avenue Road
Address :		d, LONDON, NW8 6BU		
Client Details:				
Name: Address :				
		within the SAP calculations. ations compliance.		
1a TER and DER	1			
		city (mains gas used for second		
		as used for secondary heating))		
	xide Emission Rat		13.6 kg/m ²	0
1b TFEE and DF	ioxide Emission R	ate (DER)	10.09 kg/m ²	OK
	rgy Efficiency (TFE	E)	66.5 kWh/m ²	
-	ergy Efficiency (D		55.5 kWh/m ²	
	lengy Enloicitey (D	122)	00.0 ((1111)	OK
2 Fabric U-value	S			
Element		Average	Highest	
External	wall	0.17 (max. 0.30)	0.18 (max. 0.70)	OK
Floor		0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof		0.12 (max. 0.20)	0.12 (max. 0.35)	OK
Openings		1.30 (max. 2.00)	1.30 (max. 3.30)	OK
2a Thermal brid	CONTRACTOR DOLLARS NO. 1			
and the second se		from linear thermal transmittan	ces for each junction	
3 Air permeabili			4.00 (decise a)	1994 A
Maximum	pility at 50 pascals		4.00 (design val 10.0	ue) Ok
			10.0	
4 Heating efficie		Line to see the second second	e de fine e le stine e le st	-1
Main Heatir	ig system:	Heat pumps with radiators of Ground source heat pump v	경험 사람은 사람이 다 모양을 얻었다. 그는 것은 것은 것은 바람이 가지 않을 것 같이 같이 했다.	
		Ground Source near pump (
Main Heatir	ng system 2:	Database: (rev 465, produc	t index 016566):	
		Boiler systems with radiator		ains gas
		Brand name: Remeha		9900.200
		Model: Quinta Pro 65		
		Model qualifier:		
		(Regular)		
		Efficiency 89.3 % SEDBUK	2009	

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Regulations Compliance Report

	Minimum 88.0 %		OK
Secondary heating system:	Room heaters - gas		
coordinally realing operation	Data from manufacturer -		
	Gas fire or wall heater, bala	anced flue	
	Efficiency 80.0 %		
	Minimum 63.0 %		OK
5 Cylinder insulation			
Hot water Storage:	Measured cylinder loss: 6.6		
	Permitted by DBSCG: 9.54	l kWh/day	OK
Primary pipework insulated:	Yes		OK
6 Controls			
Space heating controls	TTZC by plumbing and ele	ortrical services	OK
Space heating controls 2:		e control by suitable arrangement of plumbing an	
Hot water controls:	Cylinderstat	e control by suitable alrangement of planning an	OK
7 Low energy lights			
Percentage of fixed lights with low	v-energy fittings	100.0%	
Minimum		75.0%	OK
8 Mechanical ventilation			
Not applicable			
9 Summertime temperature			
Overheating risk (Thames valley)	1	Not significant	OK
Based on:			
Overshading:		Average or unknown	
Windows facing: East		4.79m ²	
Windows facing: East		13.04m ²	
Windows facing: East		16.83m ²	
Windows facing: East		7.19m ²	
Windows facing: South		27.04m ²	
Windows facing: South		24.57m ²	
Windows facing: South		9.8m²	
Windows facing: West		22.32m ²	
Windows facing: West		6.76m ²	
Windows facing: West		16.38m ²	
Windows facing: West		5.88m² 22.32m²	
Windows facing: North		22.32m ²	
Windows facing: North		27.9m² 16.38m²	
Windows facing: North		5.4m²	
Windows facing: North		5.4m ²	
Windows facing: North		4.08m ²	
Windows facing: North Windows facing: East		3.38m²	
Windows facing: East		33.48m²	
Windows facing: East		13.65m ²	
THILDWS IGUILY. LOST			
		/ offi-	
Windows facing: East Windows facing: East		7,8m² 5.88m²	

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Regulations Compliance Report

Ventilation rate:	4.00	
Key features		
Thermal bridging	0.023 W/m²K	
Roofs U-value	0.12 W/m ² K	
Floors U-value	0.12 W/m ² K	
Floors U-value	0.12 W/m²K	
Photovoltaic array		
Fixed cooling system		
Secondary heating (mains gas)		

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APPENDIX (iv)

PEA – PREDICTED ENERGY ASSESSMENT (PRE-EPC)

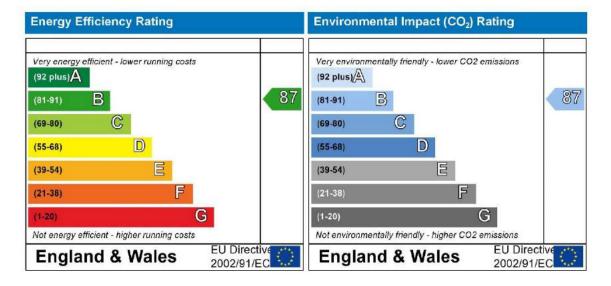
Predicted Energy Assessment



28, Avenue Road LONDON NW8 6BU Dwelling type: Date of assessment: Produced by: Total floor area: Detached House 02 October 2020 Ondrej Gajdos 2525.6 m²

This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

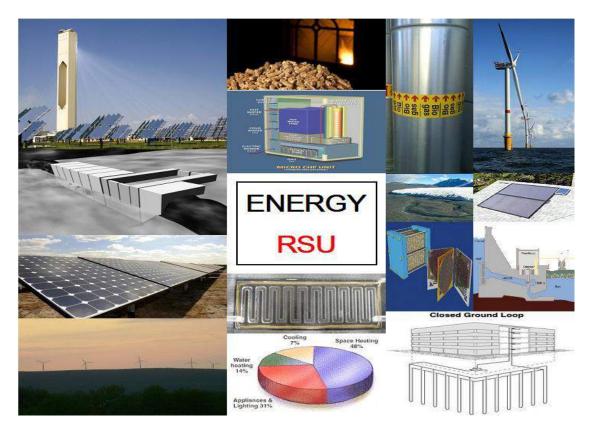


The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

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

APPENDIX (v)

ENERGY RSU – RENEWABLES & SUSTAINABILITY UNIT



ENERGY RSU is an integrated energy sustainability unit able to provide the following:

- SAP Calculations & Certificates L1A&B New/Existing Buildings (NHER certified)
- SBEM Calculations & Certificates L2A&B New/Existing Buildings (BRE certified)
- EPC & DEC Certificates New Build (CIBSE certified)
- Rd SAP Survey EPC Certificates Existing Buildings (NHER certified)
- Commercial EPC Survey certificates Existing Buildings (BRE certified) Level 3, 4 & 5
- Energy Statements & Renewable Reports for Planning
- LEED/ BREEAM assessments (USGBC/BRE certified)
- Low/Zero Carbon (LZC) and Sustainability Appraisals/designs (CIBSE Low Carbon Consultant)
- Renewable Energy Appraisals and Designs
- Carbon Rating assessments
- 2D/3D CFD and Dynamic Thermal Simulations
- EPBD Air Conditioning Inspections (Article 20) and EPBD Asset Ratings & Certificates
- Energy Usage (Running Costs)
- Utility/ Bill Analysis and Recommendations
- Advice on Green and Environmental Issues Relating to M&E Building Services
- Code for Sustainable Homes New Build and Domestic Refurbishment (BRE certified)



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M&E Consultants

Energy Consultants