

# Energy Efficiency in Buildings

## Supplemental Guide to SANS 10400-XA & SANS 204

V. 3.0

Registered to:

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Report Date:

**26 August 2014**

Competent Person:

Prof. Registration No:

Practice Name:

Client's Name:

Project Description:

Site Address:

Cadastral Description:

This report is to be read in conjunction with the applicable drawings, specifications and other relevant documentation.

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## Climatic Zone & Data

Site Location :	<input type="text"/>		
Latitude:	<input type="text"/>	South	Longitude: <input type="text"/> East
Climatic zone :	<input type="text"/>		

Average Conditions:	Wind Speed	Temperature
Summer : Dec – Feb	<input type="text"/> m/s	<input type="text"/> °C
Autumn : Mar – May	<input type="text"/> m/s	<input type="text"/> °C
Winter : Jun – Aug	<input type="text"/> m/s	<input type="text"/> °C
Spring : Sep – Nov	<input type="text"/> m/s	<input type="text"/> °C

Average Solar Irradiance:	<input type="text"/> kJ/m <sup>2</sup> /d	<input type="text"/> kWh/m <sup>2</sup> /d
Winter Solar Irradiance:	<input type="text"/> kJ/m <sup>2</sup> /d	<input type="text"/> kWh/m <sup>2</sup> /d

## Building Design - Occupancy Classification

Occupancy Classification:	<input type="text"/>
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## Building Design – Occupancy Times

Design occupancy times:	<input type="text"/> Hrs / Day	<input type="text"/> Days / Week
	<input type="text"/> Hrs / Week	<input type="text"/> Hrs / Year

## Building Design – Population

Design Population – Reg. A20:	<input type="text"/>
Design Population:	<input type="text"/>



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## Building Envelope – Primary Facade Orientation

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Building Orientation:

## Building Envelope – Floors

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### SANS 10400-XA Compliance:

Underfloor Heating Installed:

### SANS 204 Compliance:

#### **Slab-on-Ground:**

Concrete Slab-on-Ground:

Floor Heating System:

#### **Suspended Slab:**

Suspended Floor:

Floor Heating System:

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## Building Envelope – Walls

### SANS 10400-XA Compliance:

#### External Wall Construction – Wall Type 1

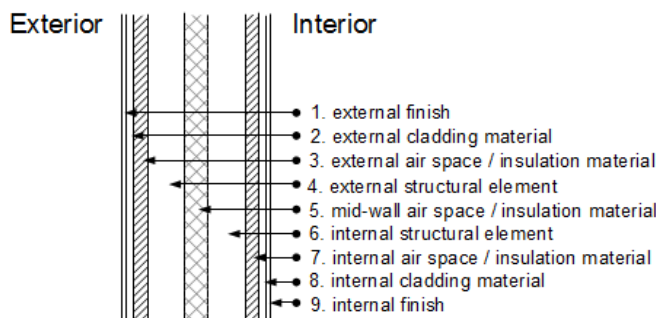
Wall construction:

#### External Wall Construction – Wall Type 2

Wall construction:

### SANS 204 Compliance:

#### External Wall Construction – Wall Type 1



Required - Min. *R*-value:  CR-value (Hrs):

	Component	Thickness (mm)	Density (kg/m <sup>3</sup> )	Conductivity <i>K</i> -value (W/mK)
<i>Exterior</i>				
2				
3				
4				
5				
6				
7				
8				
<i>Interior</i>				
	<b>Total Thickness:</b>			

#### *R*-value Achieved:

Summer : Dec – Feb	<input style="width: 80px;" type="text"/>	m <sup>2</sup> K/W
Autumn : Mar – May	<input style="width: 80px;" type="text"/>	m <sup>2</sup> K/W
Winter : Jun – Aug	<input style="width: 80px;" type="text"/>	m <sup>2</sup> K/W
Spring : Sep – Nov	<input style="width: 80px;" type="text"/>	m <sup>2</sup> K/W

#### *CR*-value Achieved :

Summer : Dec – Feb	<input style="width: 80px;" type="text"/>	hours
Autumn : Mar – May	<input style="width: 80px;" type="text"/>	hours
Winter : Jun – Aug	<input style="width: 80px;" type="text"/>	hours
Spring : Sep – Nov	<input style="width: 80px;" type="text"/>	hours

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## External Wall Construction – Wall Type 2

Required -	Min. <i>R</i> -value: <input style="width: 80%;" type="text"/>	CR-value (Hrs):	<input style="width: 95%;" type="text"/>
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	Component	Thickness (mm)	Density (kg/m <sup>3</sup> )	Conductivity <i>K</i> -value (W/mK)
<i>Exterior</i>				
2				
3				
4				
5				
6				
7				
8				
<i>Interior</i>				
	Total Thickness:			

**R-value Achieved:**

Summer : Dec – Feb	<input style="width: 95%;" type="text"/>	m <sup>2</sup> K/W
Autumn : Mar – May	<input style="width: 95%;" type="text"/>	m <sup>2</sup> K/W
Winter : Jun – Aug	<input style="width: 95%;" type="text"/>	m <sup>2</sup> K/W
Spring : Sep – Nov	<input style="width: 95%;" type="text"/>	m <sup>2</sup> K/W

**CR-value Achieved :**

Summer : Dec – Feb	<input style="width: 95%;" type="text"/>	hours
Autumn : Mar – May	<input style="width: 95%;" type="text"/>	hours
Winter : Jun – Aug	<input style="width: 95%;" type="text"/>	hours
Spring : Sep – Nov	<input style="width: 95%;" type="text"/>	hours

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## Building Envelope – Fenestration

### SANS 10400-XA Compliance:

Storey Level	Nett area (m <sup>2</sup> )	Fenestration area (m <sup>2</sup> )	Percentage (%) fenestration

### Compliance Achieved:


### Shading – Midday Summer Sunshine

North facing windows shaded:

### Permissible air leakage – Glazing

Maximum permissible air leakage for glazing elements:

Openable glazing:	<input type="text"/>	L/sm <sup>2</sup>
Non-openable glazing:	<input type="text"/>	L/sm <sup>2</sup>
Glazed double action swing and revolving doors:	<input type="text"/>	L/sm <sup>2</sup>

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## Second Storey

Orientation	Facade Area (m <sup>2</sup> )	Allowable A/C Energy Value	Achieved A/C Energy Value	SANS 204 Compliance ?
North				
North East				
East				
South East				
South				
South West				
West				
North West				

## Third Storey

Orientation	Facade Area (m <sup>2</sup> )	Allowable A/C Energy Value	Achieved A/C Energy Value	SANS 204 Compliance ?
North				
North East				
East				
South East				
South				
South West				
West				
North West				

## Fourth Storey

Orientation	Facade Area (m <sup>2</sup> )	Allowable A/C Energy Value	Achieved A/C Energy Value	SANS 204 Compliance ?
North				
North East				
East				
South East				
South				
South West				
West				
North West				

## Fifth Storey

Orientation	Facade Area (m <sup>2</sup> )	Allowable A/C Energy Value	Achieved A/C Energy Value	SANS 204 Compliance ?
North				
North East				
East				
South East				
South				
South West				
West				
North West				

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## Sixth Storey

Orientation	Facade Area (m <sup>2</sup> )	Allowable A/C Energy Value	Achieved A/C Energy Value	SANS 204 Compliance ?
North				
North East				
East				
South East				
South				
South West				
West				
North West				

## Seventh Storey

Orientation	Facade Area (m <sup>2</sup> )	Allowable A/C Energy Value	Achieved A/C Energy Value	SANS 204 Compliance ?
North				
North East				
East				
South East				
South				
South West				
West				
North West				

## Eighth Storey

Orientation	Facade Area (m <sup>2</sup> )	Allowable A/C Energy Value	Achieved A/C Energy Value	SANS 204 Compliance ?
North				
North East				
East				
South East				
South				
South West				
West				
North West				

## Ninth Storey

Orientation	Facade Area (m <sup>2</sup> )	Allowable A/C Energy Value	Achieved A/C Energy Value	SANS 204 Compliance ?
North				
North East				
East				
South East				
South				
South West				
West				
North West				

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## Tenth Storey

Orientation	Facade Area (m <sup>2</sup> )	Allowable A/C Energy Value	Achieved A/C Energy Value	SANS 204 Compliance ?
North				
North East				
East				
South East				
South				
South West				
West				
North West				

## Fenestration Summary

*Refer to Detail Fenestration Report for individual fenestration element summary.*

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## Building Envelope – Roofs

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### **SANS 10400-XA Compliance:**

#### **Roof Assembly Requirement**

Required -	Min. $R$ -value:	<input type="text"/>	$m^2 \cdot K/W$
Direction of heat flow:		<input type="text"/>	

#### **Thermal Break Material Requirement**

Metal sheet roofing fixed to metal purlins / rafters / battens ?	<input type="text"/>
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#### **Min. $R$ -value Requirement – Metal Roof Construction**

Metal sheeting type roofing material:	<input type="text"/>	
$R$ -value for roof covering material:	<input type="text"/>	$m^2 \cdot K/W$
$R$ -value for ceiling:	<input type="text"/>	$m^2 \cdot K/W$
Required added $R$ -value for insulation:	<input type="text"/>	$m^2 \cdot K/W$

#### **Min. $R$ -value Requirement – Tile Roof Construction**

Clay / concrete tile type roofing material:	<input type="text"/>	
$R$ -value for roof covering material:	<input type="text"/>	$m^2 \cdot K/W$
$R$ -value for ceiling:	<input type="text"/>	$m^2 \cdot K/W$
Required added $R$ -value for insulation:	<input type="text"/>	$m^2 \cdot K/W$

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**SANS 204 Compliance: STRICT**

**Roof Construction – Roof Type 1**

Roof assembly ventilated ?

Roof construction:

Roof Pitch:

Roof construction:	R-value (m <sup>2</sup> K/W)	
Component		
Reflective foil / radiant barrier:		
Emissivity :	<input style="width: 100px;" type="text"/>	
Insulation:		
Thickness :	<input style="width: 100px;" type="text"/>	mm
Density :	<input style="width: 100px;" type="text"/>	kg/m <sup>3</sup>
<b>R-value of Typical Roof Construction</b>		

**Roof Construction – Roof Type 2**

Roof assembly ventilated ?

Roof construction:

Roof Pitch:

Roof construction:	R-value (m <sup>2</sup> K/W)	
Component		
Reflective foil / radiant barrier:		
Emissivity :	<input style="width: 100px;" type="text"/>	
Insulation:		
Thickness :	<input style="width: 100px;" type="text"/>	mm
Density :	<input style="width: 100px;" type="text"/>	kg/m <sup>3</sup>
<b>R-value of Typical Roof Construction</b>		

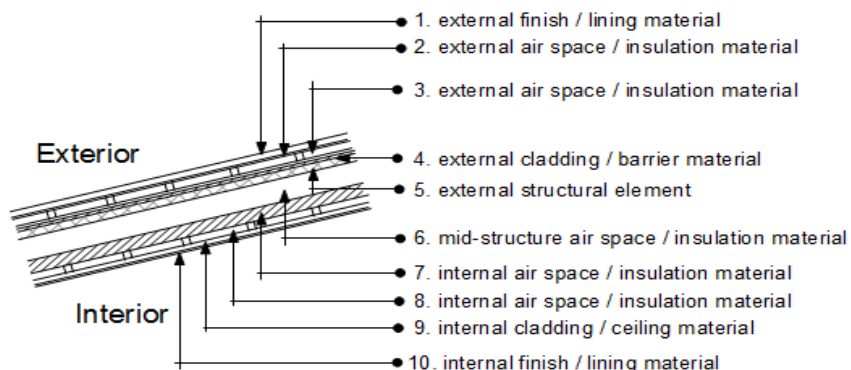
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## SANS 204 Compliance: Rational Solution

### Roof Construction – Roof Type 1 – Skillion / Lean-to / Cathedral



	Component	Thickness (mm)	Density (kg/m <sup>3</sup> )	Conductivity K-value (W/mK)
Exterior				
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
Interior				

### Achieved R-value – Roof Assembly – Roof Type 1 – Skillion / Lean-to / Cathedral

Direction of Heat Flow :	Up	Down	Up	Down
	m <sup>2</sup> K/W	m <sup>2</sup> K/W		
Summer : Dec – Feb				
Autumn : Mar – May				
Winter : Jun – Aug				
Spring : Sep – Nov				

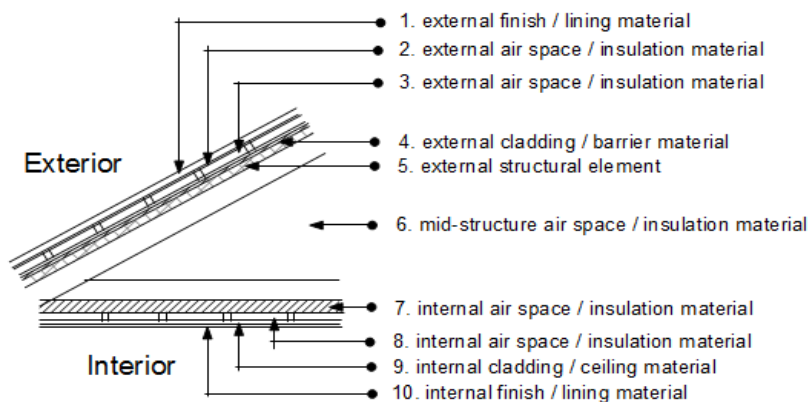
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## SANS 204 Compliance: Rational Solution

### Roof Construction – Roof Type 2 – Pitch roof with horizontal ceiling



	Component	Thickness (mm)	Density (kg/m <sup>3</sup> )	Conductivity K-value (W/mK)
Exterior				
2				
3				
4				
5				
6				
7				
8				
9				
Interior				

### Achieved R-value – Roof Assembly – Roof Type 2 – Pitch roof with horizontal ceiling

Direction of Heat Flow :	Up	Down	Up	Down
	m <sup>2</sup> K/W	m <sup>2</sup> K/W		
Summer : Dec – Feb				
Autumn : Mar – May				
Winter : Jun – Aug				
Spring : Sep – Nov				

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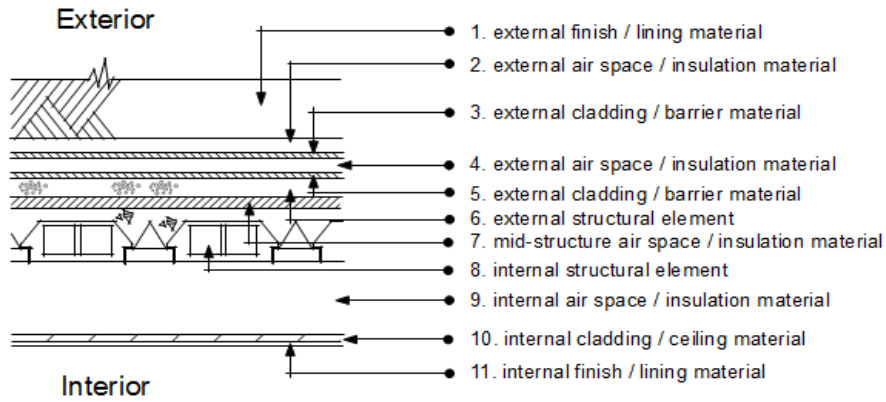


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## **SANS 204 Compliance: Rational Solution**

### **Roof Construction – Roof Type 3 – Flat roof**



	Component	Thickness (mm)	Density (kg/m <sup>3</sup> )	Conductivity K-value (W/mK)
Exterior				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Interior				

### **Achieved R-value – Roof Assembly – Roof Type 3 – Flat roof**

Direction of Heat Flow :	Up	Down	Up	Down
	m <sup>2</sup> K/W	m <sup>2</sup> K/W		
Summer : Dec – Feb				
Autumn : Mar – May				
Winter : Jun – Aug				
Spring : Sep – Nov				

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## Building Envelope – Roof Lights

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### SANS 204 Compliance

#### Permissible air leakage – Roof Lights

Maximum permissible air leakage for roof lights:

Openable glazing:  L/sm<sup>2</sup>  
Non-openable glazing:  L/sm<sup>2</sup>

#### Roof Light/s – Room / Space 1

Roof light/s serve:

Room / Space designation:  Type:

Room area:  m<sup>2</sup> No. Off:

Total area of roof light/s:  m<sup>2</sup>

Roof light shaft length:  m

Roof light as % of floor area:  % Shaft index:

SHGC not to exceed :   
Total *U*-value not to exceed:  W/m<sup>2</sup>K

#### Roof Light/s – Room / Space 2

Roof light/s serve:

Room / Space designation:  Type:

Room area:  m<sup>2</sup> No. Off:

Total area of roof light/s:  m<sup>2</sup>

Roof light shaft length:  m

Roof light as % of floor area:  % Shaft index:

SHGC not to exceed :   
Total *U*-value not to exceed:  W/m<sup>2</sup>K

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## Building Envelope – Roof Lights

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### Roof Light/s – Room / Space 3

Roof light/s serve:	<input type="text"/>		
Room / Space designation:	<input type="text"/>	Type:	<input type="text"/>
Room area:	<input type="text"/> m <sup>2</sup>	No. Off:	<input type="text"/>
Total area of roof light/s:	<input type="text"/> m <sup>2</sup>		
Roof light shaft length:	<input type="text"/> m		
Roof light as % of floor area:	<input type="text"/> %	Shaft index:	<input type="text"/>
SHGC not to exceed :	<input type="text"/>		
Total U-value not to exceed:	<input type="text"/>	W/m <sup>2</sup> K	
<input type="text"/>			

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## Building Envelope – Building Sealing

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### SANS 204 Compliance

#### Permissible air leakage – Chimneys and Flues

Burning device type:

#### Permissible air leakage – External Doors

External door serves a conditioned space ?

External door serves a habitable room in climatic zone:

External door/s of swing type:

#### Permissible air leakage – Exhaust fans

Exhaust fan/s serve a conditioned space ?

Exhaust fan/s serve a habitable room in climatic zone:

#### Permissible air leakage – Roofs, walls, floors and any openings

Roofs, external wall/s, external floors, or any opening/s (glazing or door/s) serve a conditioned space ?

Roofs, external wall/s, external floors, or any opening/s (glazing or door/s) serve a habitable room in climatic zone :

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## Building Design – Services

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### SANS 204 Compliance

#### Lighting and power

Artificial lighting:

Natural lighting:

#### Energy demand and consumption – Lighting and power

Maximum permissible -

Energy Demand (Power) Lighting:

W

Annual Energy Consumption Lighting:

kWh

#### Basement Storey

Lamp Power (W)	No. of Lamps	Hours in use / day	Energy Demand (W)	Energy Consumption (kWh)

#### Ground Storey

Lamp Power (W)	No. of Lamps	Hours in use / day	Energy Demand (W)	Energy Consumption (kWh)

#### First Storey

Lamp Power (W)	No. of Lamps	Hours in use / day	Energy Demand (W)	Energy Consumption (kWh)

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## Second Storey

Lamp Power (W)	No. of Lamps	Hours in use / day	Energy Demand (W)	Energy Consumption (kWh)

## Third Storey

Lamp Power (W)	No. of Lamps	Hours in use / day	Energy Demand (W)	Energy Consumption (kWh)

## Fourth Storey

Lamp Power (W)	No. of Lamps	Hours in use / day	Energy Demand (W)	Energy Consumption (kWh)

## Fifth Storey

Lamp Power (W)	No. of Lamps	Hours in use / day	Energy Demand (W)	Energy Consumption (kWh)

## Sixth Storey

Lamp Power (W)	No. of Lamps	Hours in use / day	Energy Demand (W)	Energy Consumption (kWh)

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## Seventh Storey

Lamp Power (W)	No. of Lamps	Hours in use / day	Energy Demand (W)	Energy Consumption (kWh)

## Eighth Storey

Lamp Power (W)	No. of Lamps	Hours in use / day	Energy Demand (W)	Energy Consumption (kWh)

## Nineth Storey

Lamp Power (W)	No. of Lamps	Hours in use / day	Energy Demand (W)	Energy Consumption (kWh)

## Tenth Storey

Lamp Power (W)	No. of Lamps	Hours in use / day	Energy Demand (W)	Energy Consumption (kWh)

## External & Security Lighting

Lamp Power (W)	No. of Lamps	Hours in use / day	Energy Demand (W)	Energy Consumption (kWh)

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## Energy Demand (Power) – Lighting

Total lamp energy demand (W) :

Available energy demand (W) :

or

Total lamp energy demand (W/m<sup>2</sup>) :

## Energy Consumption – Lighting (*per annum*)

Total energy consumption (kWh) :

Available energy consumption (kWh) :

or

Total energy consumption (kWh/m<sup>2</sup>) :

## Total Energy Demand / Consumption – Whole Building Summary

### Energy Demand

#### Max. Permissible -

Energy Demand – Building (kW):

Energy Demand – Lighting (kW):

#### Utilised -

Energy Demand – Lighting (kW):

Energy Demand – Hot Water (kW):

#### Available -

Energy Demand – Building (kW):

Energy Demand – Lighting (kW):

### Energy Consumption (*annum*)

#### Max. Permissible -

Energy Consumption – Building (kWh):

Energy Consumption – Lighting (kWh):

#### Utilised -

Energy Consumption – Lighting (kWh):

Energy Consumption – Hot Water (kWh):

#### Available -

Energy Consumption – Building (kWh):

Energy Consumption – Lighting (kWh):

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## Hot Water Services

### Hot water design requirement – Energy and storage capacity

Building Occupancy:		
Type of Accommodation?		
Hot water demand – Assumed:		
Select the Type of Accommodation.		
Daily Hot Water Demand:		L – Incl. 20% allowance for heat loss
Annual Hot Water Demand:		kL – Based on design occupancy
50 % of Annual Hot Water Demand:		kL – Incl. 20% allowance for heat loss

### Energy design consumption – Electrical resistance heating

Energy consumption – Calculated @ 60 °C :					
	Summer	Autumn	Winter	Spring	
					kWh
Energy Consumption – Daily:					kWh – Calculated @ 60 °C
Energy Consumption – Annual:					kWh – Calculated @ 60 °C
50 % of Annual Energy Consumption:					kWh – Calculated @ 60 °C

### Hot water storage requirement

Minimum Hot Water Storage Volume:		L
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### Hot water storage tank system – Adopted

Tank Storage Volume:		L
Rated Power Input:		kW
Reheat Time:		h

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## Energy consumption – Supplemental heating system

### Heat Pump System – Total HW demand – Design Requirement

Reheat Time :		h
Heat Pump Capacity:		kW – <i>Calculated</i>
Circulation Pump Size :		L/h – <i>Calculated</i>

### Heat pump system – Total HW demand – Solution Adopted

Heat Pump Capacity :		kW
Rated Power Input:		kW
Hot Water Yield:		L/h
COP:		

### Energy Consumption – Heat Pump – Total HW demand – Solution Adopted

Energy consumption – Assumed:					
	Summer	Autumn	Winter	Spring	
					kWh
Energy Consumption – Daily:					kWh
Energy Consumption – Annual:					kWh

### Heat Pump System – 50% Annual Energy demand – Design Requirement

Min. Heat Pump Capacity:		kWh – <i>Calculated</i>
Recovery Rate:		L/h – <i>Calculated</i>

### Heat pump system – 50% Annual Energy demand – Solution Adopted

Heat Pump Capacity:		kW
Rated Power Input:		kW
Hot Water Yield:		L/h
COP:		

### Energy Consumption – Heat Pump – 50% Annual Energy demand – Solution Adopted

Energy consumption – Assumed:					
	Summer	Autumn	Winter	Spring	
					kWh
Energy Consumption – Daily:					kWh
Energy Consumption – Annual:					kWh

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## Solar Hot Water (SHW) Heating System – Design Requirement

### Energy Required - Total HW demand

Solar Energy Required :  kJ/day  kWh/day

### Energy Required – 50% of Annual Energy demand – Winter

Solar Energy Required :  kJ/day  kWh/day

### Available Solar Irradiance

Average Solar Irradiance:  kJ/m<sup>2</sup>/d  kWh/m<sup>2</sup>/d

Winter Solar Irradiance:  kJ/m<sup>2</sup>/d  kWh/m<sup>2</sup>/d

## SHW system – Solution Adopted

Absorber Type:

Storage Tank Type:

Supplementary Energy Source:

## SHW System – Total HW demand

Min. Absorber Area:  m<sup>2</sup>

## Storage Tank Capacity – Total HW demand

Min. Primary Storage Tank Capacity:  L – Incl. 20% allowance for heat loss

## SHW Absorber – 50% Annual Energy demand – Winter Irradiance

Min. Absorber Area:  m<sup>2</sup>

## Storage Tank Capacity – 50% Annual Energy demand

Min. Primary Storage Tank Capacity:  L – Incl. 20% allowance for heat loss

## SHW Collector Installation

Absorber Orientation:

Absorber Tilt Angle:  Degrees from horizontal

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## Insulation Requirements – Hot Water Services

Internal diameter of Hot Water Service Pipe:	<input type="text"/>	mm
Min. Required $R$ -value for Pipe Insulation:	<input type="text"/>	
Min. Required $R$ -value for HW Vessel / Tank:	<input type="text"/>	

### Note:

Typical thermal properties of common building and insulating materials (design values) sourced from ASHRAE 2009 – Fundamentals, CIBSE Guide A, Environmental Design & BRE Publication, BEPAC Research Report, BRE/169/12/1, The Harmonisation of Thermal Properties of Building Materials, 1990

Thermal resistance of building elements is calculated in accordance with SANS 6946.

Interpolation of solar exposure factors, energy constants and heating / cooling shading multipliers is utilised in fenestration element calculations.

Hot water system calculations and volume data is sourced from SANS 10252-1 and various on-line resources.

Hot water energy consumption is calculated for a hot water requirement of 60 °C with cold water temperature based on the average ambient air temperature for the climatic zone.

Hot water demand calculations include a 20% allowance for heat loss within the water reticulation system.

Mean available solar irradiance values is based on satellite-derived meteorology and solar energy parameters sourced from NASA – Atmospheric Science Data Centre (<http://eosweb.larc.nasa.gov/>).

Source values (kWh/m<sup>2</sup>/day) converted to kJ/m<sup>2</sup>/day.

### Declaration:

I, the undersigned, hereby certify that all the information contained in this report is to the best of my knowledge and belief, true and correct.

Signature: \_\_\_\_\_

Competent Person:

Professional Registration No: