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REPUBLIC OF RWANDA

ANNEX 3

RWANDA GREEN BUILDING MINIMUM COMPLIANCE SYSTEM

ACKNOWLEDGEMENT

The Rwanda Green Building Minimum Compliance System is a result of the collaboration between the Rwanda Housing Authority (RHA), Global Green Growth Institute (GGGI), Building Construction Authority (BCA) Singapore, and Rwanda Green Building Organization (RwGBO). Government officials, department heads, and technicians from the Ministry of Infrastructure (MININFRA), the Ministry of Environment (MoE), City of Kigali (CoK), Rwanda Environment Management Authority (REMA), Rwanda Standards Board (RSB), Water and Sanitation Corporation (WASAC), Rwanda Utilities Regulatory Authority (RURA), Rwanda Energy Group (REG), Integrated Polytechnic Regional Centre (IPRC) Kigali, Rwanda Institute of Architects (RIA), Institution of Engineers Rwanda (IER) and Association of Building and Civil Works Contractors (AEBTP) deserve a great deal of recognition for their cooperation and contribution during the consultation meetings for developing the Rwanda Green Building Minimum Compliance System.

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Section 1 - Introduction

1. Overview

Rwanda has shown impressive strides in economic growth in the recent decades. This economic development has set off a construction boom in the capital city Kigali and 6 Secondary cities (Huye, Muhanga, Musanze, Rubavu, Rusizi and Nyagatare) of Rwanda identified under the erstwhile Economic Development and Poverty Reduction Strategy (EDPRS) 2013-18 as poles of growth and centers of non-agricultural economic activities. Rwanda's National Strategy for Transformation (NST1) has also set an ambitious urbanization rate of 35% by 2024 from 16.5% in 2012.

The visionary policies of the government and conducive business climate is attracting many international and national investors to setup offices, construct a large variety of mixed-use buildings, residential communities, hotels, hospitals, educational, commercial, industries and institutional buildings in Kigali and 6 Secondary cities.

A global study has estimated that 75% of the building stock is yet to be built in developing countries by the year 2050[1]. Worldwide, buildings consume 1/3rd of final energy use and in East African Countries (EAC) the share of final energy consumption of the building sector is well above 60%[2]. In 2010, the buildings sector was responsible for 1 out of 4 GHG emissions released worldwide deriving from fossil fuel consumption. But, if the embodied energy of construction materials is included, the buildings sector becomes the prime GHG emitter[3]. Thus, building design, construction and operation have a significant effect on the chances of meeting the 2 ^{0}C target and pursuing efforts to stay well below 1.5 ^{0}C[4].

Buildings are also major consumers of potable water – a finite resource. If not planned for and used judiciously, poor water management would have significant impact on the ecosystem. Buildings also have significant impact on human health, wellness and productivity, as many of us spend 90% of our time indoors, and our physical environment impacts our health more than lifestyle, medical care and genetics[5]. A study conducted by Harvard T.H. Chan School of Public Health and other leading academic research institutions has concluded that people working in green buildings have better cognitive function scores compared to a conventional building[6].

Rwanda recognizes the importance of regulating building in a manner that best supports sustainable development. In this sense, a building is viewed from both its physicality and the process by which it is created. There is need for structures and the application of processes that

[1] Sustainable Building Design for Tropical Climates, UN-Habitat, August 2014
[2] Sustainable Building Design for Tropical Climates, UN-Habitat, August 2014
[3] Sustainable Building Design for Tropical Climates, UN-Habitat, August 2014
[4] As per Paris Climate Accord to which Republic of Rwanda is a signatory
[5] International WELL Building Institute
[6] https://chge.hsph.harvard.edu/resource/impact-green-buildings-cognitive-function

are environmentally responsible and resource-efficient throughout a building's life-cycle: from planning to design, construction, operation, maintenance, renovation, and demolition.

2. Rationale for Green Building in Rwanda

What is a Green Building?

Green building is defined differently by various users, but there is a consensual agreement on the fact that it is an outcome of a design philosophy which focusses on increasing the efficiency of resource use while reducing building impacts on human health and the environment during the building life cycle. Green building promotes energy & water efficiency, takes advantage of the ambient (upland) climate, reduces the need for air-conditioning usage, maximizes natural ventilation, maximizes use of sustainable & locally manufactured buildings materials, provides superior Indoor Environmental Quality (IEQ) to building occupants, protects environment and promotes biodiversity.

Benefits of Green Building

Globally, the tangible & intangible benefits of green building would vary depending on the climate, building type, usage, occupants, number of hours the building is in operation, baselines used to validate savings, rating achieved by the building, and the country context.

From a general perspective, green building is given a credit in the following:

- **Energy Efficiency & Water Conservation:** Optimizing energy and water resources does not only decrease the use of natural resources but also decreases water and energy expenditure.
- **Improved Indoor Air Quality:** Green building reduces the need for air-conditioning usage by maximizing natural ventilation.
- **Reduced Carbon Footprint:** by producing less waste and reducing the release of harmful gasses.
- **Promotion of sustainable construction materials:** Green building promotes the adoption of building designs, construction practices and materials that are environmentally friendly.

3. Policy Context

3.1. International Context

A. UN Sustainable Development Goals (SDGs)

Green building is relevant to several targets of the UN Sustainable Development Goals (SDGs) for 2030, wherein:

Goal 3: Good Health & Wellbeing - Ensure healthy lives and promote wellbeing for all at all ages: Green building features, such as improved lighting, better air quality and greenery, remain relevant to positively impact health and wellbeing. Reducing emissions from buildings – particularly in cities – can reduce pollution and improve air quality, benefiting the health of city dwellers.

Goal 7: Affordable and Clean Energy - Ensure access to affordable, reliable, sustainable and modern energy for all: Green building promotes the use renewables energy, which can be cheaper than fossil fuel alternatives.

Goal 8: Decent Work & Economic Growth - Promote inclusive and sustainable economic growth, employment and decent work for all: As the demand for green building grows globally, so does the workforce required to deliver them, and this is another goal that green building can significantly contribute to.

Goal 9: Industry, Innovation & Infrastructure - Build resilient infrastructure, promote sustainable industrialization and foster innovation: Green buildings must be designed in a way that ensures they are resilient and adaptable in the face of our changing global climate. This is critically important in developing countries, many of which will be particularly susceptible to the effects of climate change.

Goal 11: Sustainable Cities & Communities - Make cities inclusive, safe, resilient and sustainable: Buildings are the foundations of cities, and green buildings are therefore key to their long-term sustainability. Whether homes, offices, schools, shops or green spaces – the built environment contributes to the make-up of communities, which must be sustainable to ensure a high quality of life for all.

Goal 12: Responsible Consumption & Production - Ensure sustainable consumption and production patterns: The building industry has a major role to play in preventing waste through reduction, recycling and reuse – “Circular economy” principles where resources are not wasted.

Goal 13: Climate Action - Take urgent action to combat climate change and its impacts: Buildings are responsible for over 30 per cent of global greenhouse gas emissions, and are therefore a major contributor to climate change. But by the same token, green buildings have huge potential to combat it, offering one of the most cost-effective ways to do so, through measures such as energy efficiency.

Goal 15: Life on Land - Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss: The materials that make up a building are key to determining its sustainability. And so, the building industry and its supply chains have a major role to play in using responsibly sourced materials such as timber. Green building certification tools also recognize the need to reduce water use, and the value of biodiversity and the importance of ensuring it is protected, and incorporate this into the space they build on both during and after construction - minimizing damage and designing ways to enhance biodiversity, such as through landscaping with local flora.

B. Paris Agreement on Climate Change

In December 2015, 179 countries and the EU gathered in Paris hammering out the final wording of an agreement to keep global temperature increase well below 2 degrees Celsius and if possible, below 1.5 degrees Celsius. The reduction in temperature can only be achieved through a significant reduction in the emission of greenhouse gases. Known as COP21 (The 21st Conference of the Parties to the UN Framework Convention on Climate Change).

This agreement is a comprehensive framework for action on climate change, guiding the steps all nations will take to reduce their contribution to global warming. Paris Agreement on Climate Change – a historic international treaty that aims to limit global temperature increases to 2 degrees Celsius with an ambition to keep increases below 1.5 degrees.

The Paris agreement was ratified on 27 September 2016 through a Presidential Order and Rwanda then deposited its instrument of ratification to the Secretary-General of the United Nations on 6 October 2016.

Rwanda's National Determined Contribution (NDC) is built upon its National Strategy for Climate Change and Low Carbon Development Strategy. The Rwanda NDCs mitigation contribution are GHG emissions reduction through promotion of renewable energy, efficiency resilient transport systems, green industry promotion, low carbon urban systems, adoption of energy and water efficiency standards into the building codes and employ low urban carbon planning.

Green building contribution towards the achievement of that Government commitment to Paris Agreement on climate change is important since the building is main pillar of low carbon urban system as buildings emit a considerable amount of GHG. In addition to that the Green Building Minimum Compliance Guideline is establishing energy and water efficiency standards as part of Building regulatory framework.

C. Montreal protocol Kigali Amendment

The Montreal Protocol on Substances that Deplete the Ozone Layer was designed to reduce the production and consumption of ozone depleting substances to reduce their abundance in the atmosphere, and thereby protect the earth's fragile ozone Layer. The 2016 Kigali Amendment to the Montreal Protocol could avoid up to 0.5^0C of warming by phasing out Fluorinated gases (F-gases)[7] used in cooling.

The Amendment shall enter into force on 1 January 2019, provided that at least twenty instruments of ratification, acceptance or approval of the Amendment have been deposited by States or regional economic integration organizations that are Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer. As on 17 January 2019, 66 parties have ratified the amendment.

3.2. National Context

A. National Green Growth and Climate Resilience Strategy

The National Green Growth and Climate Resilience strategy for climate change and low carbon development of GoR, 2011 has highlighted that buildings should be designed to reduce the demand of energy and water and to support waste recycling under Program of Action 10: Low Carbon Urban Systems and has suggested to adopt water and energy efficiency standards into building codes. The strategy further highlights that implementation of low energy standards in buildings and services in Rwanda could result in an 80% reduction in energy use.

B. National Urbanization Policy

One of the four pillars of The National Urbanization Policy is densification. Likewise, in its Policy Statement No 4 it is stipulated that urban development shall reflect the efficient use of land and be based upon green development principles.

C. National Roadmap for Green Secondary City Development

Under the National Roadmap for Green Secondary City Development, Building and Construction has been identified as one of the key pillars to achieve green urbanization. The National roadmap proposes the promotion of green building designs, use of locally produced sustainable materials for building construction and development of a local green building certification system.

[7] Fluorinated gases (F-gases) are man-made gases that can stay in the atmosphere for centuries and contribute to a global greenhouse effect. There are four types: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF6) and nitrogen trifluoride (NF3)

D. National Housing Policy

Through its Pillar 2, the National Housing Policy details provisions for the resource planning efficiency, green technology and professionalism.

4. Scope of Green Building Minimum Compliance System

Rwanda Green Building Minimum Compliance System is conceived as simple, effective and environmental performance-oriented indicators designed to promote energy & water efficiency, environmental protection, better Indoor Environmental Quality to building occupants and green innovation. These indicators are mandatory in nature and would be applicable for new Category 4 & 5 buildings as per Ministerial Order Determining Urban Planning and Building Regulations. The indicators would be applicable for:

- Commercial buildings (excluding warehouses and retail shops)
- Public administrative and institutional buildings (excluding correctional services, police, fire department)
- Social, cultural & assembly buildings
- Health facilities
- Educational buildings (excluding living areas for students)

Although the green building minimum compliance system is not mandatory for residential developments, willing building owners and real estate developers are encouraged to adopt as applicable on a voluntary basis the green building minimum compliance system to meet sustainable development targets.

5. **Green Building Minimum Compliance System Overview**

The green building minimum compliance system comprise of 5 modules or focus areas targeting

1. **Energy efficiency** - This module focuses on the approach that can be used in the building orientation, design, material and equipment selection to optimize the energy performance in building.

2. **Water efficiency** - This module focuses on rainwater harvesting, selection of water efficient fittings, waste water treatment and other features that would reduce the use of potable water during building operation.

3. **Environmental protection** - This category focuses on the design, practices and selection of materials and resources that would reduce the environmental impacts of built structures.

4. **Indoor Environmental Quality** - This category focuses on the design strategies that would enhance the indoor environmental quality which includes fresh outdoor air provision, thermal comfort, noise and selection of non-toxic paints in buildings.

5. **Innovation and Other green features** - This category focuses on the adoption of green practices and new technologies that are innovative and have potential environmental benefits.

29 green building indicators cutting across five modules are defined in the draft document and are weighed at **190** points. Each green building indicator is allocated points based on the relative importance of its contribution to green building goals. Points are allocated based on the environmental impact, efforts required for implementation and the costs associated with implementation.

Although the green building minimum compliance system is mandatory for Category 4 & 5 buildings, there is a degree of flexibility for building owners or developers to choose green indicators based on the suitability to the building, location, usage and the benefits associated.

Section 2 – Green Building Minimum Compliance Indicators

1. Green Building Indicators and Point Allocation

Category		Mandatory/ Optional	Points Allocation
Module 1 – Energy Efficiency			
1.1	Building Envelope – Facade Design Parameters	Optional	25
1.2	Ventilation	Optional	15
1.3	Daylighting	Optional	17.5
1.4	Artificial Lighting Efficiency	Mandatory	5
1.5	Enhanced Artificial Lighting Efficiency	Optional	9
1.6	Lifts and Escalators	Optional	3
1.7	Renewable Energy	Optional	5
1.8	Solar Hot Water Systems	Mandatory	5
1.9	Energy Metering	Optional	2
1.10	Air Conditioning System	Optional	7.5
1.11	Building Envelope – Air-conditioned space	Optional	8
Sub-total for Energy Efficiency			**102**
Module 2 – Water Efficiency			
2.1	Rain Water Harvesting	Mandatory	4
2.2	Efficient Plumbing Fixtures	Mandatory	3
2.3	Enhanced Efficient Plumbing Fixtures	Optional	6
2.4	Waste Water Treatment and Reuse	Mandatory Optional	16
2.5	Water Metering	Optional	2
Sub-total for Water Efficiency			**31**
Module 3 – Environment Protection			
3.1	Sustainable Concrete Usage	Optional	5
3.2	Greenery Protection	Optional	10
3.3	Environment Friendly Practices	Optional	2
3.4	Low-impact Refrigerants: Zero Ozone Depletion Potential	Mandatory	2
3.5	Low-impact Refrigerants: Low Global Warming Potential	Optional	4
3.6	Segregation of Waste, Post-occupancy	Optional	2
3.7	Heat Island Mitigation	Optional	3
Sub-total for Environmental Protection			**28**
Module 4 – Indoor Environmental Quality			
4.1	Minimum Outdoor Fresh Air Supply – Mechanically Ventilated Spaces	Mandatory	4
4.2	Thermal Comfort – Mechanically Ventilated Spaces	Mandatory	2
4.3	Noise level	Mandatory	2
4.4	Low VOC Paints and Adhesives	Optional	2
Sub-total for Indoor Environmental Quality			**10**
Module 5 – Innovation and Other Green Features			
5.1	Innovation	Optional	10
5.2	Universally Accessible Building	Mandatory	9
Sub-total for Innovation and Other Green Features			**19**
		Grand total	**190**

2. Minimum Compliance Scoring Criteria

For a project to achieve green building minimum compliance, the building shall implement all the mandatory indicators and must score a minimum of **60** points out of **190** points

Mandatory indicators are non-negotiable in nature and every building shall comply. As an encouragement, points are awarded for projects fulfilling mandatory indicator requirements.

The project should demonstrate mandatory compliance to the following mandatory indicators, as applicable:

- 1.4 Artificial Lighting Efficiency
- 1.8 Solar Hot Water Systems
- 2.1 Rain Water Harvesting
- 2.2 Efficient Plumbing Fixtures
- 2.4 Waste Water Treatment
- 3.4 Low-impact Refrigerants: Zero Ozone Depletion Potential
- 4.1 Minimum Outdoor Fresh Air Supply – Mechanically Ventilated Spaces
- 4.2 Thermal Comfort – Mechanically Ventilated Spaces
- 4.3 Noise Level
- 5.3 Universally Accessible Building

Optional indicators as the name suggests are optional and the building may choose to comply based on the applicability and the benefits envisaged.

3. Abbreviations and Acronyms

ASHRAE – American Society of Heating, Refrigeration and Air-Conditioning Engineers

COP – Coefficient of Performance

CUI – Concrete Usage Index

EIA – Environment Impact Assessment

GWP – Global Warming Potential

IEQ – Indoor Environmental Quality

LED – Light Emitting Diode

LPD – Lighting Power Density

LPF – Litres per Flush

LPM – Litres per Minute

ODP – Ozone Depletion Potential

RSB – Rwanda Standards Board

SHGC – Solar Heat Gain Coefficient

SRI – Solar Reflective Index

U value – Thermal transmittance

VOC – Volatile Organic Compounds

VVVF – Variable Voltage Variable Frequency

WWR – Window to wall ratio

Module 1 – Energy Efficiency

Indicators and point allocation

S.No.	Indicator Title	Optional / Mandatory	Points Allocation
1.1	Building Envelope – Façade Design Parameters	Optional	25
1.2	Ventilation	Optional	15
1.3	Daylighting	Optional	17.5
1.4	Artificial Lighting Efficiency	Mandatory	5
1.5	Enhanced Artificial Lighting Efficiency	Optional	9
1.6	Lifts and Escalators	Optional	3
1.7	Renewable Energy	Optional	5
1.8	Solar Hot Water Systems	Mandatory	5
1.9	Energy Metering	Optional	2
1.10	Air Conditioning System	Optional	7.5
1.11	Building Envelope – Air-conditioned space	Optional	8
	Sub-total for Energy Efficiency		**102**

1.1 BUILDING ENVELOPE: FAÇADE DESIGN PARAMETERS

Optional — Points: 25

Intent:

Minimize heat gain, improve indoor thermal comfort and reduce the energy for conditioning the indoor environment through efficient design of building's western facade

Applicability:

This indicator is optional and is applicable to all buildings

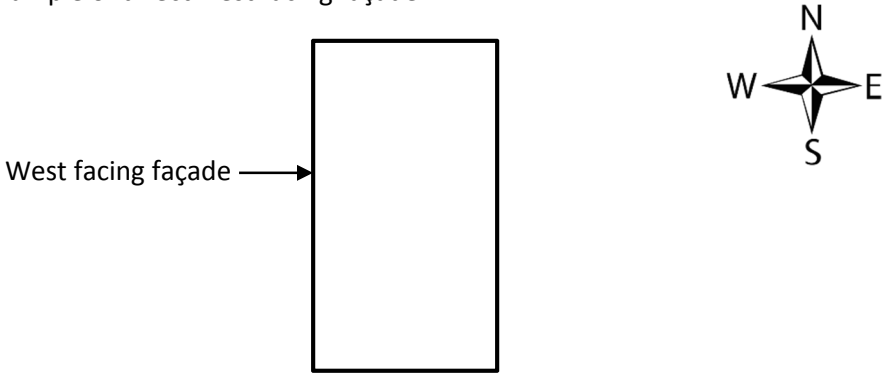
Indicator Requirement:

Requirement	Scoring Scheme
(A): Minimum direct west facing façade through building design orientation Note: Orientation of façade that falls within the range of 22.5^0 North of West and 22.5^0 South of West will be defined as west facing facade. Core walls for lifts, staircases and toilets that are located within this range are exempted in computation.	Points scored = 15 – 0.3 x (% of west facing facade areas over total façade areas) (Up to 15 points)
(B)(i): Minimum west facing window openings (And/Or) (B)(ii): Effective sun shade provision for windows on the west façade with minimum shading of 30%.	Points scored = 10 - 0.1 x (% of west facing window areas over total west facing façade areas) Points scored = 0.1 x (% of west facing window areas with sun shading devices over total west facing façade areas) (Up to 10 points for B(i) & B(ii))

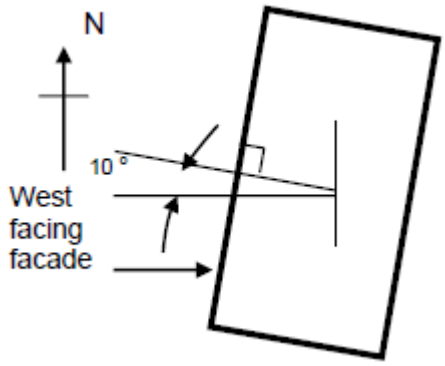
Illustrations:

(A): Minimum direct west facing façade through building design orientation

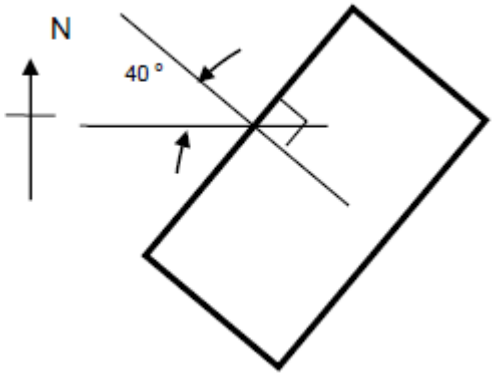
Example 1 – An example of direct west facing façade



Example 2 – The block is orientated 10^0 North of West that is less than of 22.5^0 North of West. In this instance, the façade is defined as 'west facing façade'.



Example 3 – The block is orientated 40^0 North of West that exceeds 22.5^0 North of West and hence the façade is not considered as 'west facing façade' in the computation.



(B)(i): Minimum west facing window openings; and/ or

(B)(ii): having effective sun shading provision for windows on the west façade with minimum shading of 30%.

Important note: For (B)(ii) Points can only be scored if the sun shading devices meet at least a shading of 30% as tabulated in Table below:

Table 1: Minimum Requirement on Shading Devices for West Façade

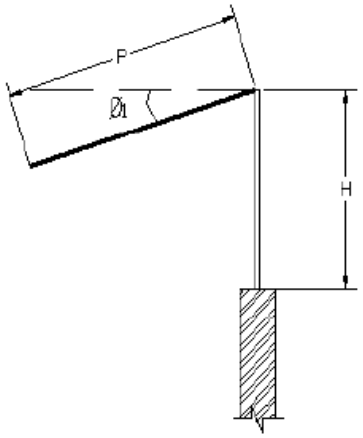
Types of Sun shading Devices	Angle of Inclination	Desired Shading			
		30%	40%	50%	60%
Horizontal Shading (R1)	0^0	0.6	0.9	1.5	
	20^0	0.4	0.6	0.9	1.8
	40^0	0.4	0.5	0.7	1.1
Vertical Shading (R2)	0^0	2.1			
	20^0	1.1	1.7	2.5	
	40^0	0.7	1	1.4	
	50^0	0.6	0.9	1.1	2.8

Where

Horizontal Shading/Projections (R_1)

$$R_1 = \frac{P}{H}$$

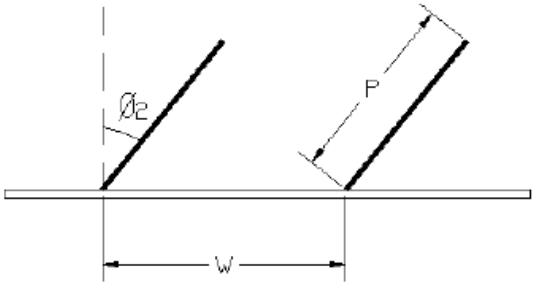
ϕ_1 = Angle of inclination



Vertical Shading/Projections (R_2)

$$R_2 = \frac{P}{W}$$

ϕ_2 = Angle of inclination



Documentary Evidence:

For (A): Minimum direct west facing façade through building design orientation

1. Architectural plans and elevation drawings of the façades of all blocks (as applicable). Highlight areas that are considered as west facing façade; and

2. Calculation showing the percentage of west facing façade areas in the prescribed tabulated format as shown in sample 1

For (B)(i) Minimum west facing window openings and/ or (B)(ii): having effective sun shading provision for windows on the west façade with minimum shading of 30%

1. Architectural plans and elevation drawings of west facing façade and window openings;
2. Sectional drawings showing the details of the sun shading devices. Highlight those sun shading devices that meet the 30% shading requirement;
3. Window schedules or drawings showing the areas of the west facing windows; and
4. Calculation showing the percentage of west facing window areas in the prescribed tabulated format as shown in sample 2

Sample 1:

Step 1: Determine the total areas of external façade

Step 2: Identify the façade areas that are within the range of 22.5^0 North of West and 22.5^0 South of West as west facing facades

Background information on sample project

Block 1: Total façade areas = 6000 m^2

West facing façade areas = 1500 m^2

Block 2: Total façade areas = 3000 m^2

West facing façade areas = 1000 m^2 (These wall areas are envelope of core wall for lifts, staircases and toilets)

Table 2: Minimum direct west facing external facade

	Area of west facing external façade (m^2) (a)	Total area of external façade (m^2) (b)	% of west facing external facade
Block 1	1500	6000	∑ (a) / ∑ (b) x 100
Block 2	Exempted from calculation (Please refer to the note under requirement)	3000	
Total	1500	9000	

Points scored for (A) = 15 – 0.3 x (% of west facing facade areas over total façade areas)

= 15 – [0.3 x (∑ (a) / ∑ (b)) x 100]

= 15 – [0.3 x (1500 / 9000) x 100] = 10 points

Sample 2:

Step 1: Identify the façade areas that are within the range of 22.5^0 North of West and 22.5^0 South of West as west facing façade.

Step 2: Determine the window areas on these facades.

Step 3: Determine if the sun shading provisions meet the minimum 30% shading.

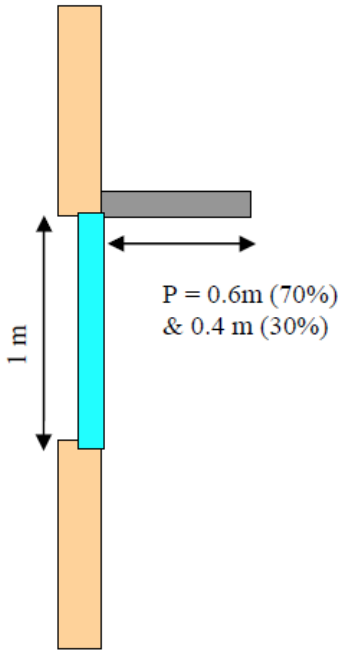
Background information on sample project

Block 1: West facing façade areas = 1500 m^2

Window areas = 600 m^2

There are two types of sun shading devices; 70% of the units have sun shading devices with horizontal projection (P) of 0.6 m and the rest of the 30% have sun shading devices with projection of 0.4 m.

Illustration 1: Sectional detail of horizontal sun shading devices



Check: To determine if the sun shading provisions (i.e. horizontal projection (P)) meet the minimum 30% shading.

For type 1 sun shading devices with 0.6m horizontal projection for 70% of the window units

Refer to Table 1

Angle of inclination – 0^0

R1 = 0.6 as per Table 1

Minimum Horizontal Projection P = R1 x H

= 0.6 x 1 = 0.6m

Therefore, sun shading devices with horizontal projection of 0.6m is considered as effective.

For type 2 sun shading devices with 0.4m horizontal projection for 30% of the window units

Refer to Table 1

Angle of inclination – 0^0

R1 = P / H

= 0.4 / 1 = 0.4

Minimum Horizontal Projection P = R1 x H

= 0.4 x 1 = 0.4m

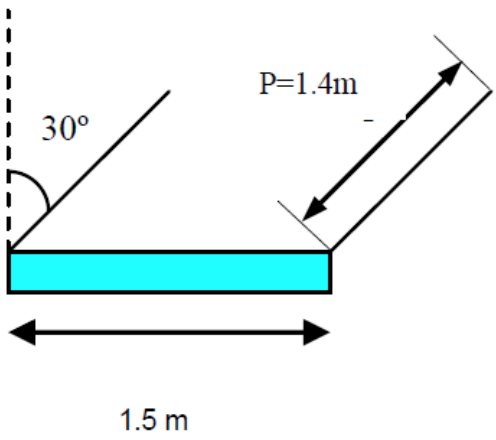
Therefore, sun shading device with horizontal projection of 0.4m will not be considered as effective

Background information on sample project

Block 2: West facing façade areas = 1500 m^2

Window areas = 1000 m^2

lustration 2: Plan of vertical sun shading devices



Check: To determine if the sun shading provisions (i.e. vertical projection (P)) meet the minimum 30% shading.

Refer to Table 1

Angle of inclination – 30^0

R2 value is not available in Table 1 for an angle of inclination of 30^0 and hence should be interpolated as below

R2 = (1.1 + 0.7) / 2 = 0.9

Minimum Vertical Projection P = R2 x W

= 0.9 x 1.5 = 1.35m

Therefore, sun shading devices with vertical projection of 1.4 m are considered as effective.

Background information on sample project

Block 3: West facing façade areas = 1000 m^2 (These wall areas are envelope of core wall for lifts, staircases and toilets)

Window areas = 0 m^2

Points scored for (b)(i) and (b)(ii) are as follows:

Table 3(b)(i): Minimum west facing windows openings

Description	Area of west facing window area (m2) (a)	Total area of west facing external façade (m2) (b)	% of west facing window areas over total west facing external façade areas
Block 1	600	1500	∑ (a) / ∑ (b) x 100
Block 2	1000	1500	
Block 3	0	1000	
Total	1600	4000	

Points scored for (B)(i) = 10 – 0.1 x (% of west facing facade areas over total façade areas)

= 10 – [0.1 x (∑ (a) / ∑ (b)) x 100]

= 10 – [0.1 x (1600 / 4000) x 100] = 6 points

Table 3(b)(ii): Effective sun shading provisions for west facing window with minimum 30% shading

Description	Area of west facing window with effective sun shading provision (m2) (a)	Total area of west facing external façade (m2) (b)	% of west facing window areas over total west facing external façade areas
Block 1	420 (70% of 600)	1500	∑ (a) / ∑ (b) x 100
Block 2	1000	1500	
Block 3	0	1000	
Total	1420	4000	

Points scored for (B)(ii) = 0.1 x (% of west facing facade areas over total façade areas)

= 0.1 x [(∑ (a) / ∑ (b)) x 100]

= 0.1 x [(1420 / 4000) x 100] = 3.55 points

Therefore, points scored for (B)(i) and (B)(ii) = 6 + 3.55 = 9.55 points < 10 points (maximum points that can be scored)

1.2 VENTILATION

Optional Points: 15

Intent:

This indicator aims at providing adequate natural ventilation in all non air-conditioned building areas, to provide thermally comfortable and healthy spaces for the building occupants. This indicator also encourages use of energy efficient design and control of ventilation systems in common areas to enhance building performance.

Applicability:

This indicator is applicable to

1. All Non Air-Conditioned building areas (excluding carparking area)
2. Common areas in the building

Indicator requirement:

Requirement	Scoring Scheme
1. Natural Ventilation for Non air-conditioned building areas: Encourage building design that facilitates good natural ventilation. Proper design of building layout that utilizes prevailing wind conditions to achieve adequate cross ventilation. Note: In Kigali, the prevailing wind directions are from North to South. Hence, buildings designed with window openings facing the north and south directions have the advantage of the prevailing wind conditions that would enhance indoor thermal comfort. Meteorological data on the more precise wind direction and velocity of the site location can also be used as the basis for the design.	1 point for every 10% of units/rooms with window openings facing north and south directions. Points scored = 1 x (% of units/10) (Up to 10 points)
2. For common areas in the building: Encourage the use of energy efficient design and control of ventilation system in the following common areas: I. Toilets II. Staircases III. Corridors	Extent of Coverage: At least 90 % of each applicable area Points scored based on the mode of ventilation provided in applicable areas **Natural ventilation – 1 point for each area**

IV. Lift lobbies V. Atrium	**Mechanical ventilation – 0.5 point for each area** (Up to 5 points)

Illustrations

1. **Natural Ventilation for Non air-conditioned building areas:**

It is not necessary for the window openings to be located perpendicularly to the prevailing wind direction. An oblique angle is considered acceptable (see illustrations below).

Illustration 1 - Building layout shows all rooms with window openings facing the north and south directions.

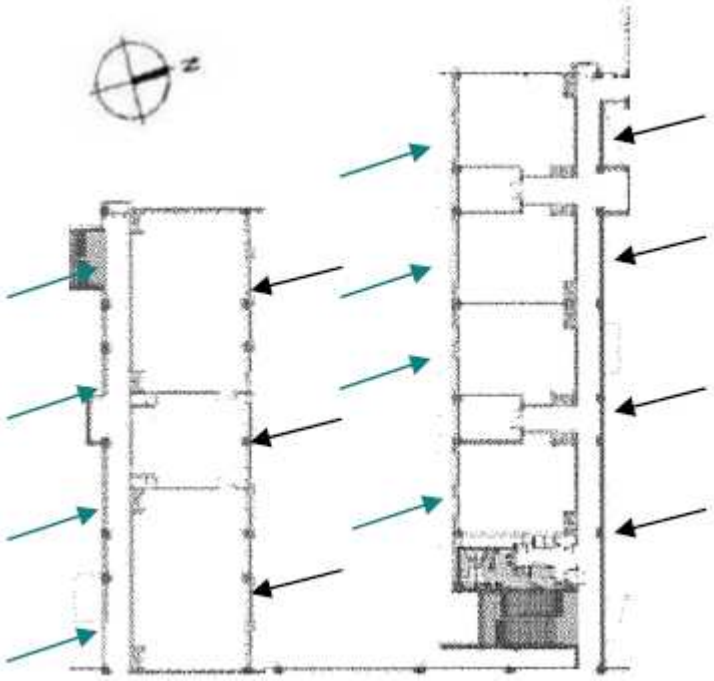
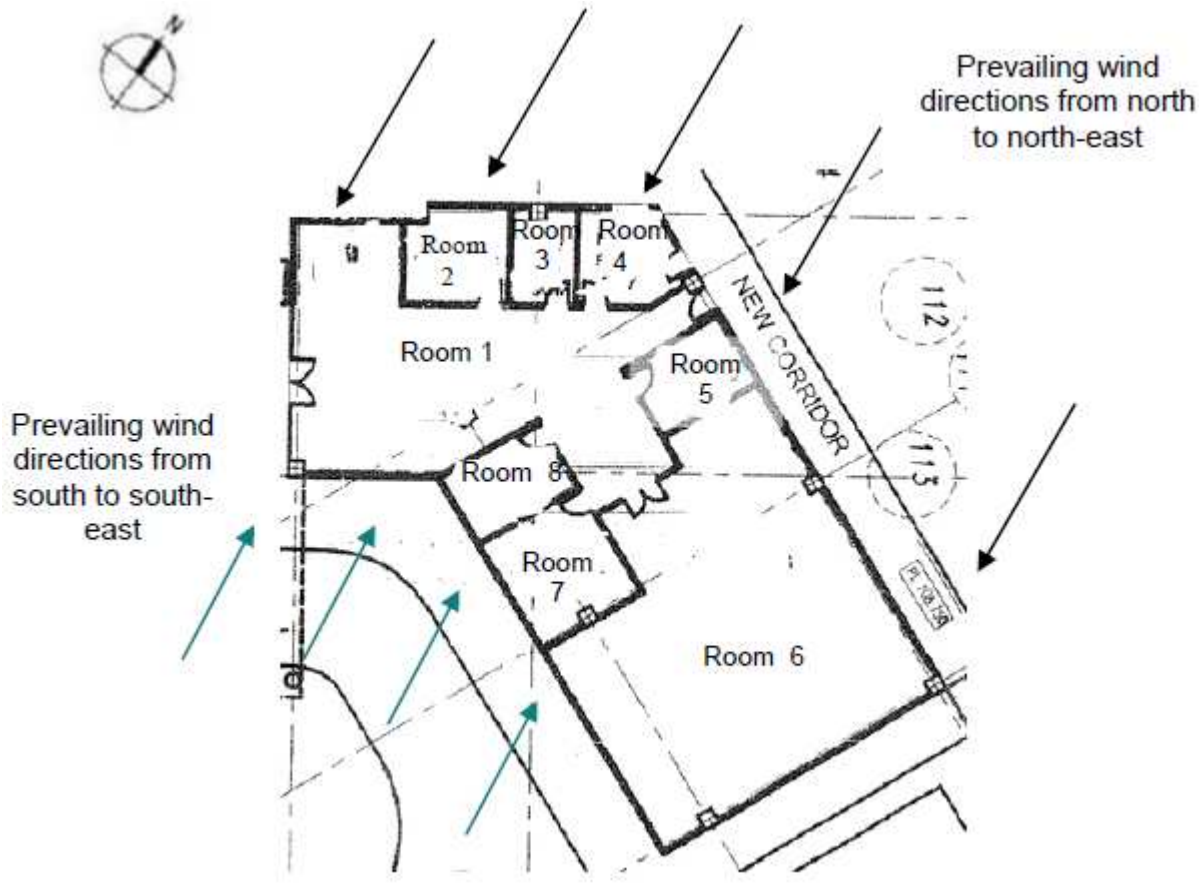


Illustration 2 - Building layout shows not all rooms with window openings facing the north and south directions.



Building layout shows not all rooms with window openings facing the north and south directions. Room 2 to Room 5, Room 7 and Room 8 would only have prevailing wind in one direction. Only Room 1 and 6 can be considered meeting the requirement.

Documentation Required:

For Natural Ventilation in Non air-conditioned building areas:

1. Architectural plans showing the units / rooms of all blocks with highlights of those with window openings in the N-S direction;
2. Calculation showing the percentage of units or rooms with window openings facing north and south directions in the prescribed tabulated format as shown in the worked example Sample 1

For common areas in the building:

1. Plan layouts showing the applicable areas and the respective modes of ventilation; and
2. Schedules showing the numbers, locations of the applicable areas and the modes of ventilation used.

Sample 1 for Natural Ventilation in Non air-conditioned building areas

Background information on sample project

A school development comprises two 1-storey classroom block A and A1 with majority of the window openings facing the N-S direction, a 2 storey classroom Block B with window opening in the E-W direction and two blocks of office and computer rooms with majority of the window opening facing the N-S direction and one block of meeting rooms that are air-conditioned

S.No.	Description	Units/Rooms with window openings in the N-S direction (a)	Total no. of naturally ventilated units/room (b)	% of units/rooms with window openings in N-S direction
1	Classroom Block A and A1	40	60	∑ (a) / ∑ (b) x 100
2	Classroom Block B	0	40	
3	Office and computer rooms	5	10	
4	Meeting room air-conditioned	NA	NA	
	Total	45	110	

Points scored = 1 x (% of units / 10)

= 1 x [(∑ (a) / ∑ (b) x 100) / 10]

= 1 x [(45/110 x 100) / 10] = 4.09 points which can be approximated to 4.1 points

Sample 2 for common areas in the building

Background information on sample project

Number of toilets = 45; where 10 units are designed with mechanical ventilation and 35 units are designed with natural ventilation

% of toilet units with natural ventilation = (45-10)/45 = 77.8 % < 90% of extent of coverage required and hence no point for this item

Number of staircases = 2; all are mechanical ventilated – 0.5 point

Number of Corridors = 10; all are naturally ventilated – 1 point

Number of lift lobbies = 2; all are mechanically ventilated – 0.5 points

Number of Atriums = 1; mechanically ventilated – 0.5 point

Points scored = 0.5 +1 + 0.5 + 0.5 = 2.5 points < 5 points (maximum points that can be scored)

1.3 DAYLIGHTING

Optional Points: 17.5

Intent:

Ensure connectivity between the interior and the exterior environment, by providing adequate daylighting.

Applicability:

This is an optional indicator and is applicable to regularly occupied spaces and common areas in the building

Indicator Requirement:

Requirement	Scoring Scheme
(A) For regularly occupied areas: The building can choose any one of the following options or a combination, to show compliance: Option 1 - Simulation Approach Option 2 - Measurement Approach Notes: 1. Regularly occupied areas are those where people sit or stand as they work, irrespective of the number of days occupied in a year. Regularly occupied areas shall include only enclosed spaces. 2. Regularly occupied areas include work stations, cabins, meeting rooms, classrooms etc.; whereas, areas with audio-visual facilities such as auditoriums, conference rooms, etc., can be excluded from this calculation, with justification and supporting documents. **Option 1 - Simulation option** Demonstrate through computer simulation that 75% of the regularly occupied spaces in the building achieve daylight illuminance levels for a minimum of 100 Lux (and a maximum of 2,200 Lux) in a clear sky condition on 21st September at 12 noon, at working plane.	Extent of Coverage: At least 75% of regularly occupied area 15 points

Areas with 2,200 Lux or more daylight illumination levels should not be considered. **Option 2 - Measurement option** Demonstrate through daylight illuminance measurement that 75% of the regularly occupied spaces in the building achieve daylight illuminance levels for a minimum of 100 Lux. Areas with 2,200 Lux or more daylight illumination levels shall be not considered. Measurements shall be taken after installation of furniture, equipment & systems at work plane height at 9 am, 12 pm, and 3 pm, on a 3-meter square grid. To show compliance, consider the average of the measurements taken at 9 am, 12 pm, and 3 pm.	
(B): For common areas: Demonstrate adequate daylighting provision in the following common areas: I. Toilets II. Staircases III. Corridors IV. Lift lobbies V. Atrium	Extent of Coverage: At least 75% of each applicable area 0.5 point each (Up to 2.5 points)

Documentation Required:

(A) For regularly occupied areas:

1. Architectural plans showing the regularly occupied areas in all floors of the building;
2. Simulation report and calculation showing the percentage of regularly occupied areas designed to achieve adequate daylight illuminance levels; or
3. Measurement report and calculation showing the percentage of regularly occupied areas designed to achieve adequate daylight illuminance levels in the prescribed format as shown in the worked example Sample 1.

(B): For common areas:

1. Drawings showing the use of daylighting for toilets, staircases, corridors, lift lobbies and atriums as applicable. Refer Sample 2 for prescribed format.

Sample 1: For regularly occupied areas:

Proposed development comprises of a school building with classrooms, staffrooms, laboratories, library. All the above spaces are considered as regularly occupied areas and occupy 90% of the total floor area of the school.

The project has opted for measurement option, and the measurements were taken after installation of furniture, equipment & systems at work plane height at 9 am, 12 pm, and 3 pm, on a 3-meter square grid. The average of the measurements taken at 9 am, 12 pm, and 3 pm indicate that more than 75% of the regularly occupied area has achieved daylight illuminance within the specified range (between 100 lux – 2200 lux)

Hence 15 points are awarded (maximum points that can be scored)

Sample 2: For common areas:

All staircases, corridors, lift lobbies and atriums are designed with adequate daylighting that would eliminate the need for artificial lightings during daytime.

70% of the toilet areas have daylighting provision while the other 30% of the toilet areas would need to employ the use of artificial lightings during daytime to maintain proper lighting level.

0.5 point each for staircases, corridors, lift lobbies and atriums

No point for toilets as it does not meet the minimum 75% of the applicable areas

Therefore, points scored for 1-5(b) = 2 points < 2.5 points (maximum points that can be scored)

Additional Guidance for User:

Potential design strategies to achieve daylighting for projects pursuing measurement option:

Every room can be provided with natural lighting by means of one or more windows having a total area of not less than 10% of clear floor area of such room and an upper limit of total area not exceeding 25% of clear floor area of such room to avoid over-lit spaces. Projects can also increase the daylight availability, through selection of higher Visual Light Transmittance (VLT>50) for the glass.

1.4 ARTIFICIAL LIGHTING EFFICIENCY

Mandatory Points: 5

Intent:

Encourage the use of energy efficient lighting to minimize energy consumption from lighting usage while maintaining proper lighting level.

Applicability:

This is a mandatory indicator and is applicable for interior lighting, including tenant lighting

Indicator Requirement:

Requirement	Scoring Scheme
The project Lighting Power Density (LPD) and illuminance (lux) for interior spaces to meet baseline values as shown in table below	5 points for meeting baseline lighting power densities

Lighting Power Density and Illuminance Levels

Type of Usage	Interior Space		LPD (W/m^2)	Illuminance (lux)
Office, Work and Study	Office, meeting rooms, copy/ print rooms, class rooms		12	300
	Lecture theatres, computer rooms, reading areas		12	500
	Laboratories		16	500
Food and Relax	Food courts, canteens (inc. dining area & food preparation)		10	200
	Restaurants, lounges, bar (inc. dining area and food preparation, accent, display)		12	200
Transport and Goods	Circulation areas, corridors, warehouses		7	100
	Stairs, escalators, travellators		6	150
	Car parks		3	75
	Loading docks		5	150
	Storage areas		10	100
Rest, clean, exercise, play areas	Hotel guest rooms		12	200
	Toilets, changing rooms, laundries, washing areas		10	100
	Gymnasiums and physical exercise areas		11	300
Atrium, halls and retail	Entrance halls, atrium, concourses, lobbies, auditoriums and concert halls		10	200
	Multipurpose halls		16	300
	Retail, general lighting and (accent, display, decorative)	Jewelry and crystal	15 (+20)	1000
		Furniture, clothing and accessories, cosmetics, artwork	15 (+10)	750

		-others (e.g. supermarket, vehicles, etc.)	15 (+5)	500
Manufacturing and Maintenance	Mechanical and electrical room		10	200
	Manufacturing – low to extra high bays		13	500
	Manufacturing – electronic manufacturing and fine detail		14	500

Documentation Required:

1. Submit building lighting layout plan for all floors
2. Submit lighting schedules showing the numbers, locations and types of lighting luminaries use
3. Submit calculations of the proposed lighting power density in the prescribed tabulated format as shown in the sample
4. Technical product information of the lighting luminaries used

Sample:

A four-story building has retail on the ground floor and offices on the top three floors.

Step 1: Determine the total power consumption based on the lighting layout design for each area and light fitting types used.

Table: Total power consumption based on each fitting type

Description	**Areas (m^2)** **A**	**Light Fitting Type** **B**	**Power Consumption per fitting (Watt)** **C**	**Ballast Loss (Watt)** **D**	**No. of fittings** **E**	**Total power consumption based on fitting type (W)** **(C+D) x E**
Office						
Office Space Type 1	1500	T5	2x28	3	245	14455
Office Space Type 2	1250	T5	2x28	3	210	12390
Meeting Room	75	T8	1x36	3	15	585
		Surface downlight	2x26	0	8	416
Corridors Type 1	150	T5	2x28	3	15	885
Corridors Type 2	205	T5	2x28	3	15	885
		Surface downlight	1x70	0	9	630
Atrium	850	T8	2x36	3	87	6525
		Surface downlight	1x150	0	10	1500
Car Parks	7500	T5	2x28	3	436	25724

Staircase	300	T5	2x28	3	20	1180
Retail						
Furniture store	2000	T5	2x28	3	300	17700
Super Market	1500	T5	2x28	3	200	11800
Toilets	10	T5	1x36	3	3	117
					Total	**94792**

Step 2: Calculate the total power consumption based on the maximum lighting power density stated in indicator requirements

Table: Total power consumption based on design and indicator requirements

Description	**Areas (m^2)**	**Design Data**		**Indicator Requirements**	
		Total Power Consumption (by area) (Watts)	**Design Lighting Power Density (W/m^2)**	**Reference Lighting Power Density (W/m^2)**	**Reference Total Power Consumption (by area) (Watts)**
	(A)	**(F)**	**(F/A)**	**(H)**	**(H x A)**
Office					
Office Space Type 1	1500	14455	9.64	12	18000
Office Space Type 2	1250	12390	9.91	12	15000
Meeting Room	75	1001	13.35	12	900
Corridors Type 1	150	885	5.90	7	1050
Corridors Type 2	205	1515	7.39	7	1435
Atrium	850	8025	9.44	10	8500
Car Parks	7500	25724	3.43	3	22500
Staircase	300	1180	3.93	6	1800
Retail					
Furniture store	2000	17700	8.85	15	30000
Super Market	1500	11800	7.86	15	22500
Toilets	10	117	11.7	10	100
	Total	**94792**			**121785**

Step 3: Calculate whether the total power consumption is within baseline requirement

As per table under Step 2, total design lighting power consumption = 94,792 Watts

The total reference lighting power consumption = 121,785 Watts

Since the total design lighting power consumption is below the total reference lighting power consumption, the project has scored 5 points for this mandatory requirement.

The project is eligible to score additional points in the following indicator 1.5 Enhanced Artificial Lighting Efficiency as it has demonstrated improvement in lighting power consumption.

1.5 ENHANCED ARTIFICIAL LIGHTING EFFICIENCY

Optional Points: 9

Intent:

Encourage the use of energy efficient lighting to minimize energy consumption from lighting usage while maintaining proper lighting level.

Applicability:

This is an optional indicator and is applicable for interior lighting, including tenant lighting

Indicator Requirement:

Requirement	Scoring Scheme
The project Lighting Power Density (LPD) and illuminance (lux) for interior spaces to meet and exceed baseline values as shown in table below	0.3 point for every percentage improvement in lighting power densities Points scored = 0.3 x (% improvement) (Including tenant lighting provision) (Up to 9 points) (For buildings excluding tenant lighting provision) (Up to 5 points)

Lighting Power Density and Illuminance Levels

Type of Usage	Interior Space	LPD (W/m^2)	Illuminance (lux)
Office, Work and Study	Office, meeting rooms, copy/ print rooms, class rooms	12	300
	Lecture theatres, computer rooms, reading areas	12	500
	Laboratories	16	500
Food and Relax	Food courts, canteens (inc. dining area & food preparation)	10	200
	Restaurants, lounges, bar (inc. dining area and food preparation, accent, display)	12	200
Transport and Goods	Circulation areas, corridors, warehouses	7	100
	Stairs, escalators, travellators	6	150
	Car parks	3	75
	Loading docks	5	150
	Storage areas	10	100
Rest, clean, exercise, play areas	Hotel guest rooms	12	200
	Toilets, changing rooms, laundries, washing areas	10	100
	Gymnasiums and physical exercise areas	11	300

Atrium, halls and retail	Entrance halls, atrium, concourses, lobbies, auditoriums and concert halls		10	200
	Multipurpose halls		16	300
	Retail, general lighting and (accent, display, decorative)	Jewelry and crystal	15 (+20)	1000
		Furniture, clothing and accessories, cosmetics, artwork	15 (+10)	750
		-others (e.g. supermarket, vehicles, etc.)	15 (+5)	500
Manufacturing and Maintenance	Mechanical and electrical room		10	200
	Manufacturing – low to extra high bays		13	500
	Manufacturing – electronic manufacturing and fine detail		14	500

Documentation Required:

1. Submit building lighting layout plan for all floors
2. Submit lighting schedules showing the numbers, locations and types of lighting luminaries use
3. Submit calculations of the proposed lighting power density and the percentage improvement in the prescribed tabulated format as shown in the sample
4. Technical product information of the lighting luminaries used

Sample:

A four-story building has retail on the ground floor and offices on the top three floors.

Step 1: Determine the total power consumption based on the lighting layout design for each area and light fitting types used.

Table: Total power consumption based on each fitting type

Description	**Areas (m^2)** **A**	**Light Fitting Type** **B**	**Power Consumption per fitting (Watt)** **C**	**Ballast Loss (Watt)** **D**	**No. of fittings** **E**	**Total power consumption based on fitting type (W)** **(C+D) x E**
Office						
Office Space Type 1	1500	T5	2x28	3	245	14455
Office Space Type 2	1250	T5	2x28	3	210	12390
Meeting Room	75	T8	1x36	3	15	585
		Surface downlight	2x26	0	8	416
Corridors Type 1	150	T5	2x28	3	15	885

Corridors Type 2	205	T5	2x28	3	15	885
		Surface downlight	1x70	0	9	630
Atrium	850	T8	2x36	3	87	6525
		Surface downlight	1x150	0	10	1500
Car Parks	7500	T5	2x28	3	436	25724
Staircase	300	T5	2x28	3	20	1180
Retail						
Furniture store	2000	T5	2x28	3	300	17700
Super Market	1500	T5	2x28	3	200	11800
Toilets	10	T5	1x36	3	3	117
					Total	**94792**

Step 2: Calculate the total power consumption based on the maximum lighting power density stated in indicator requirements

Table: Total power consumption based on design and indicator requirements

Description	**Areas (m^2)**	**Design Data**		**Indicator Requirements**	
		Total Power Consumption (by area) (Watts)	**Design Lighting Power Density (W/m^2)**	**Reference Lighting Power Density (W/m^2)**	**Reference Total Power Consumption (by area) (Watts)**
	(A)	**(F)**	**(F/A)**	**(H)**	**(H x A)**
Office					
Office Space Type 1	1500	14455	9.64	12	18000
Office Space Type 2	1250	12390	9.91	12	15000
Meeting Room	75	1001	13.35	12	900
Corridors Type 1	150	885	5.90	7	1050
Corridors Type 2	205	1515	7.39	7	1435
Atrium	850	8025	9.44	10	8500
Car Parks	7500	25724	3.43	3	22500
Staircase	300	1180	3.93	6	1800
Retail					
Furniture store	2000	17700	8.85	15	30000
Super Market	1500	11800	7.86	15	22500
Toilets	10	117	11.7	10	100
	Total	**94792**			**121785**

Step 3: Calculate the percentage improvement in the total power consumption

% improvement in the lighting power consumption = [Σ(HxA) - Σ(F)] /Σ(HxA) x 100

= (121785-94792)/121785 x 100

= 22.16%

Points scored = 0.3 x 22.16% = 6.64 points

Therefore, points scored is 6.64 points if tenant's lighting is included;

and points scored is 5 points (max) if tenant's lighting is excluded.

1.6 LIFTS AND ESCALATORS

Optional Points: 3

Intent:

Encourage the use of energy efficient lifts and escalators

Applicability:

This is an optional indicator and is applicable to all lifts & escalators in the building

Indicator Requirement:

Requirement	Scoring Scheme
Lifts and/or escalators equipped with AC Variable Voltage and Variable Frequency (VVVF) motor drive and sleep mode features.	Extent of Coverage: All lifts and escalators Lifts – 1.5 point Escalators – 1.5 point

Documentation Required:

1. Extracts of the tender specification indicating the types of lifts, escalators and related features used; and
2. Technical information of the lifts and escalators.

Sample:

Proposed development has the following provision:

Two lift types: Type L1 with VVVF motor drive and sleep mode features

Type L2 with VVVF motor drive and sleep mode features

Two escalator types: Type E1 with VVVF motor drive and occupancy sensors

Type E2 without VVVF motor drive and occupancy sensors

1.5 point for the use of lifts with VVVF and sleep mode features.

No point for escalators as not all escalators are designed with occupancy sensors

Points scored = 1.5 point

1.7 RENEWABLE ENERGY

Optional Points: 5

Intent:

Encourage the use of on-site renewable technologies, to reduce the net demand for fossil fuel energy and the environmental impacts associated with its use

Applicability:

This is an optional indicator and is applicable to all buildings

Indicator Requirement:

Requirement	Scoring Scheme
Demonstrate on-site renewable energy generation for at least 1% of total annual energy consumption of the building (interior & exterior areas) Notes: 1. Renewable energy sources include solar energy, wind power, biomass, etc. 2. Solar hot water systems cannot be considered as power generation source and cannot be subtracted from the total annual energy consumption of the proposed case. 3. The total annual energy consumption can be arrived through prescriptive approach 4. Owner-occupied buildings following Prescriptive approach should estimate the total annual energy consumption of the building by calculating the energy consumption of all mechanical and electrical equipment & systems based on the number of hours of operation per day 5. Tenant-occupied buildings following Prescriptive approach should estimate the total annual lighting energy consumption of the building by calculating the energy consumption of all lighting fixtures (including lighting fixtures in tenant-occupied spaces and	1 point for every 1% on-site renewable energy generation to the total annual energy consumption of the building (capped at 5 points)

exterior lighting fixtures) based on the number of hours of operation per day.	

Documentation Required:

1. A narrative describing estimated total annual energy consumption of the building
2. Calculations showing percentage energy demand met through renewable energy generation to the total annual energy consumption of the building as shown in the sample
3. Roof plans showing the location of on-site renewable energy system
4. Extracts of the tender specification indicating proposal to install renewable energy generation system
5. Photographs of installed on-site renewable energy system (To be submitted to the building inspector during verification/inspection stage)

Sample:

Background information of the sample building:

Estimated total annual energy consumption of the building = 438,000 kWh

Building proposes to generate 5% of the estimated annual consumption = 5% x 438,000 = 21,900 kWh

The building must install renewable energy system that can generate 21,900 kWh on an annual basis.

The project scores 5 points = 5 points (maximum points that can be scored)

Any, additional percentage improvement will be acknowledged under innovation indicator

1.8 SOLAR HOT WATER SYSTEMS

Mandatory Points: 5

Intent:

Encourage use of solar energy for water heating applications in the building, to minimize the environmental impacts associated with the use of fossil fuel energy.

Applicability:

This indicator is mandatory and applicable to all premises with hot water requirements of a capacity exceeding one hundred litres (100 L) per day

Indicator Requirement:

Requirement	Scoring Scheme
Install Solar Water Heating System to meet 100% of the Total Hot Water Requirements of the Building	5 points

Documentation Required:

1. A narrative describing estimated daily hot water requirements of the building
2. Calculation showing 100% of the total hot water requirements meeting through solar water heating system
3. Extracts of the tender specification indicating proposal to install solar water heating system
4. Purchase receipt of solar hot water heating system; or Photographs of installed solar hot water systems (To be submitted to the building inspector during verification/inspection stage)

Sample:

Background information of the sample building:

Estimated daily hot water requirements of the hotel building = 2000 litres

Hotel proposes to install solar water heating system to meet 100% of daily hot water requirement

The building scores 5 points (maximum points that can be scored)

1.9 ENERGY METERING

Optional Points: 2

Intent:

Encourage sub-metering and continuous monitoring to identify improvement opportunities in building's energy performance.

Applicability:

This indicator is optional and is applicable to all buildings

Indicator Requirement:

Requirement	Scoring Scheme
Install sub-metering for at least one of the following energy use applications, as applicable: 1. Interior, common and exterior area lighting 2. Air-conditioning system 3. On-site pumping for water storage 4. Waste water treatment 5. Renewable energy generation 6. Power backup systems (Generators sets etc.,) 7. Elevators, Escalators etc., 8. Any other energy consuming equipment and systems	0.5 point for sub-metering for at least one energy use applications (capped at 2 points)

Documentation Required:

1. A narrative describing the installed energy meters and their respective end uses in the building
2. Calculations showing the sub-meters installed for various energy use applications in the prescribed tabulated format shown in the sample
3. Schematic drawing showing the location of energy meters in the building
4. Purchase receipts of the energy meters; or Photographs of installed energy meters (To be submitted to the building inspector during verification/inspection stage)

Sample:

Example of a Commercial building showing various sub-meters installed

S.No.	Energy use application	Sub-meter installed
1	Interior, common and exterior area lighting	Yes
2	Air-conditioning system	Yes
3	On-site pumping for water storage	No
4	Waste water treatment	Yes
5	Renewable energy generation	Not applicable as the project has not installed Renewable energy system

6	Power backup system – Generator set	Yes
7	Elevators and Escalator	Yes

Total number of sub-meters installed = 5

Points awarded = 2.5 = 2 (maximum points that can be awarded)

1.10 AIR CONDITIONING SYSTEM EFFICIENCY

Optional Points: 7.5

Intent:

Reduce energy consumption during operation of a building through efficient air-conditioning system design where required to reduce negative environmental impacts from energy use

Applicability:

This is an optional indicator and is applicable to all Air-Conditioned areas within the building

Indicator Requirement:

Requirement	Scoring Scheme
Demonstrate improvement in efficiency of air-conditioning equipment over minimum efficiency requirements measured in terms of Coefficient of Performance (COP) or Energy Efficiency Ratio (EER) or Rwanda Seasonal Energy Efficiency Ratio (RSEER) Note: Refer Appendix A for minimum efficiency requirements for air-conditioning equipment	1.5 point awarded for every 5% improvement in efficiency of air-conditioning equipment (capped at 7.5 points)

Documentation Required:

1. A list of all air-conditioning equipment & systems installed in the project, demonstrating that they are at least 5% energy efficient vis-a-vis the baseline COP/ EER/ RSEER requirements
2. Manufacturer's data sheets of the air-conditioning system specifying COP/ EER/ RSEER information (as applicable); and
3. For systems including more than one type of air-conditioning system, the building team must provide the ton-weighted average COP/ EER/ RSEER efficiency calculation as shown in the sample
4. Air-conditioning layout drawings/ schematic showing the location of the external and internal units
5. Photographs of the installed external and internal air-conditioning units (To be submitted to the building inspector during verification/inspection stage)

Sample:

Background information of the sample building:

A hotel building has installed the following air-conditioning equipment in the guest rooms and meeting rooms

- 30 guest rooms with unitary air-conditioning system (air cooled) of 1-ton capacity each and fixed speed with a RSEER of 4.0
- 2 Meeting rooms installed with air-cooled VRF air-conditioners of 5-ton capacity and a EER of 3.3

Step 1: Refer Appendix A; Unitary air-conditioning system (air cooled) and VRF air-conditioner (air cooled) proposed in the project and their capacities/type are measured in terms of kWr as per appendix

Step 2: Convert tons into kWr to understand under which baseline reference value the proposed system falls under; 1 Ton = 3.516 kWr

Step 3: 1 Ton = 3.516 kWr; Similarly, 5 Tons = 3.516 x 5 = 17.58 kWr

S.No.	**Description**	**Capacity (Tons) (x)**	**Proposed RSEER/ EER (a)**	**Baseline RSEER/ EER as per Appendix A (b)**	**Improvement in EER (a-b)**	**Weighted average of air-conditioning efficiency**
1	Guest rooms	30 (1 ton capacity each for 30 rooms)	4.0	3.5	0.5	[(x)(corresponding a-b) + (x)(corresponding a-b) / ∑x] x 100
2	Meeting rooms	5	3.3	3.28	0.02	

Weighted average of air-conditioning efficiency = $\frac{(30)(0.5) + (5)(0.02)}{35} \times 100$

$= 43.14\%$

Points scored = As per the scoring scheme, 1.5 point awarded for every 5% improvement in efficiency of air-conditioning equipment

The building has demonstrated 43.14% improvement in air-conditioning system efficiency, and the project can score 8 points. But the total points scored by the project is 7.5 (max. points that can be scored by the project in this indicator).

Additional Guidance for User:

Coefficient of Performance (COP)

COP is the measure to determine efficiency of air conditioning systems. The COP is the total output of cooling energy per electricity input. The COP for cooling is defined as the ratio of the rate of heating energy removal to the rate of electrical energy input, in consistent units, for a complete air conditioning system or some specific portion of that system under designated operating conditions. The formula to calculate COP is explained below.

$$\mathbf{COP} = \frac{Q\ out}{W\ in}$$

Where:

Q_{out} = heating energy removal (kW)

W_{in} = electrical energy input (kW)

Energy Efficiency Ratio (EER)

The ratio of net cooling capacity in kW to total rate of electric input in watts under design operating conditions.

Rwanda Seasonal Energy Efficiency Ratio (RSEER)

The seasonal cooling energy efficiency developed using ISO CSPF with a Rwanda outdoor temperature distribution

Source: Rwandan Ministry of Environment, National Cooling Strategy, December 2018

1.11 BUILDING ENVELOPE: AIR-CONDITIONED SPACE

Optional Points: 8

Intent:

Reduce energy consumption of a building through design of an efficient building envelope, to reduce negative environmental impact from energy use

Applicability:

This indicator is optional and is applicable to Air-Conditioned Building Areas

Indicator Requirement:

<table>
<tr><th>Requirement</th><th>Scoring Scheme</th></tr>
<tr><td>The building must ensure that the following building envelope measures meet the baseline criteria:

1. Maximum U-value of the Overall Wall Assembly = 2 W/m^{2o}K

2. Maximum U-value of the Overall Roof Assembly = 1 W/m^{2o}K

3. Maximum Solar Heat Gain Coefficient (SHGC) value of fenestration corresponding to the Window to Wall Ratio (WWR)

<table><tr><th>Window to Wall Ratio (WWR)</th><th>Maximum Solar Heat Gain Coefficient (SHGC) of fenestration (W/m^{2o}K)</th></tr><tr><td>≤40%</td><td>0.40</td></tr><tr><td>>40%</td><td>0.30</td></tr></table>
4. Maximum Glazing U-value corresponding to the Window to Wall Ratio (WWR)

<table><tr><th>Window to Wall Ratio (WWR)</th><th>Maximum Glazing U-value (W/m^{2o}K)</th></tr><tr><td>≤40%</td><td>5.7</td></tr><tr><td>>40%</td><td>3.3</td></tr></table>
Note:
• Please refer Appendix B for typical U-values of sample building components.
• The U-value calculations and technical cut sheets shall supersede the typical U-values mentioned in Annexure.</td><td>2 points awarded for ensuring that the project meets the baseline values for each of the criteria

(capped at 8 points)</td></tr>
</table>

Documentation Required:

For U-value of Overall Wall Assembly

1. Submit section of external wall assemblies proposed in the project
2. U-value calculations for wall assemblies in design case vis-a-vis the indicator baseline requirements
3. Technical cut sheets indicating the U-value of wall insulation, if applicable

For U-value of Overall Roof Assembly

1. Submit section of external roof assemblies proposed in the project
2. U-value calculations for roof assemblies in design case vis-a-vis the indicator baseline requirements
3. Technical cut sheets indicating the U-value of roof insulation, if applicable

For SHGC value of fenestration

1. Submit Window to wall ratio calculations for each façade of the building
2. Technical cut sheets indicating the SHGC value of fenestration

For U-value of Glazing

1. Submit Window to wall ratio calculations for each façade of the building
2. Technical cut sheets indicating the U-value of fenestration

Sample:

Projects can calculate the U-value of overall Wall assembly and overall Roof assembly with a freely available U-value calculator on the internet. See below link:

http://www.thermalcalconline.com/u-value-calculator/u-value-opaque/u-value-opaqueExcel.html

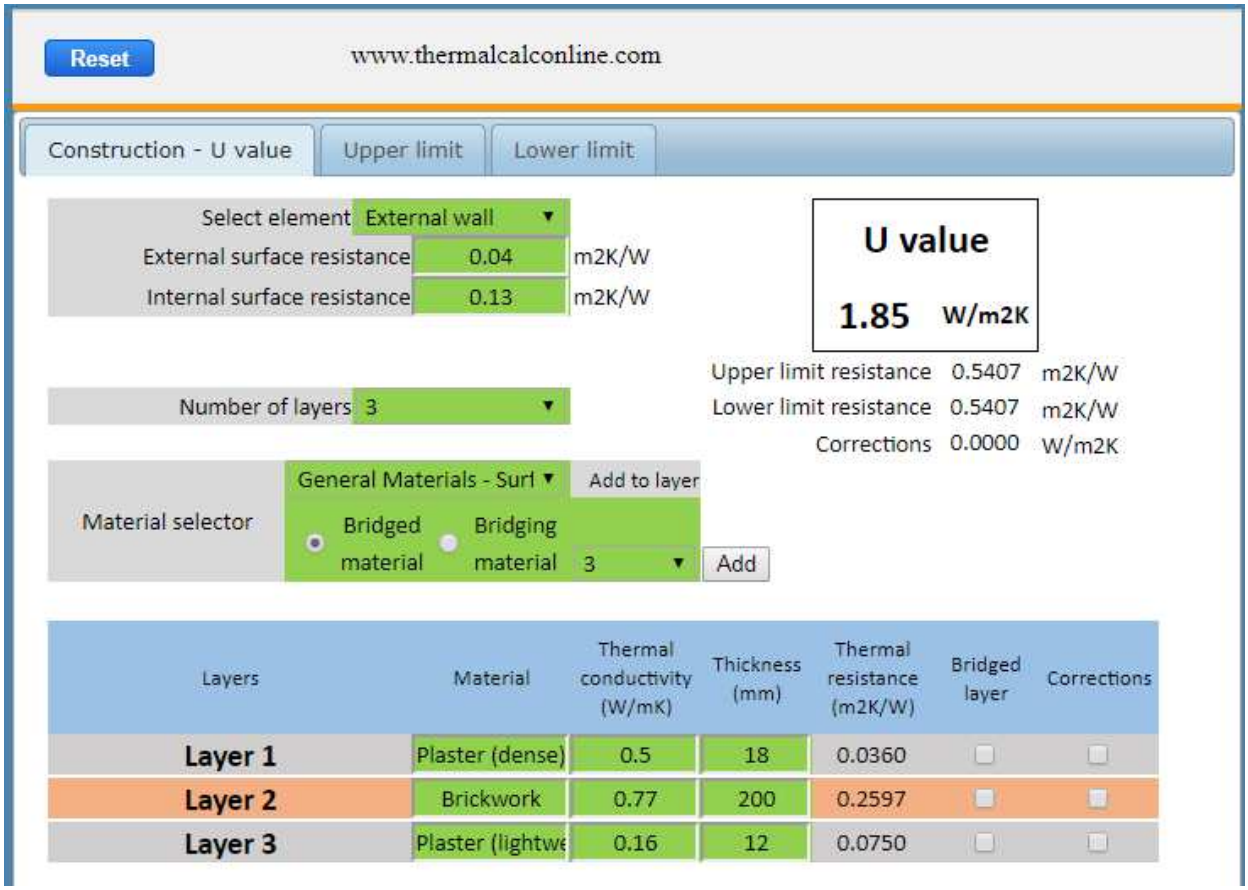
Illustration 1

Sample calculation showing U-value of overall wall assembly of 230 mm thickness. Materials in the wall assembly include external cement plaster of 18 mm thickness, brickwork of 200mm thickness and internal cement plaster of 12 mm thickness.

As per the calculator, the overall U-value of the wall assembly is 1.85 $W/m^{2o}K$ < 2 $W/m^{2o}K$

Hence the project achieves 2 points under U-value of overall Wall Assembly

Illustration 1



Source: www.thermalcalconline.com

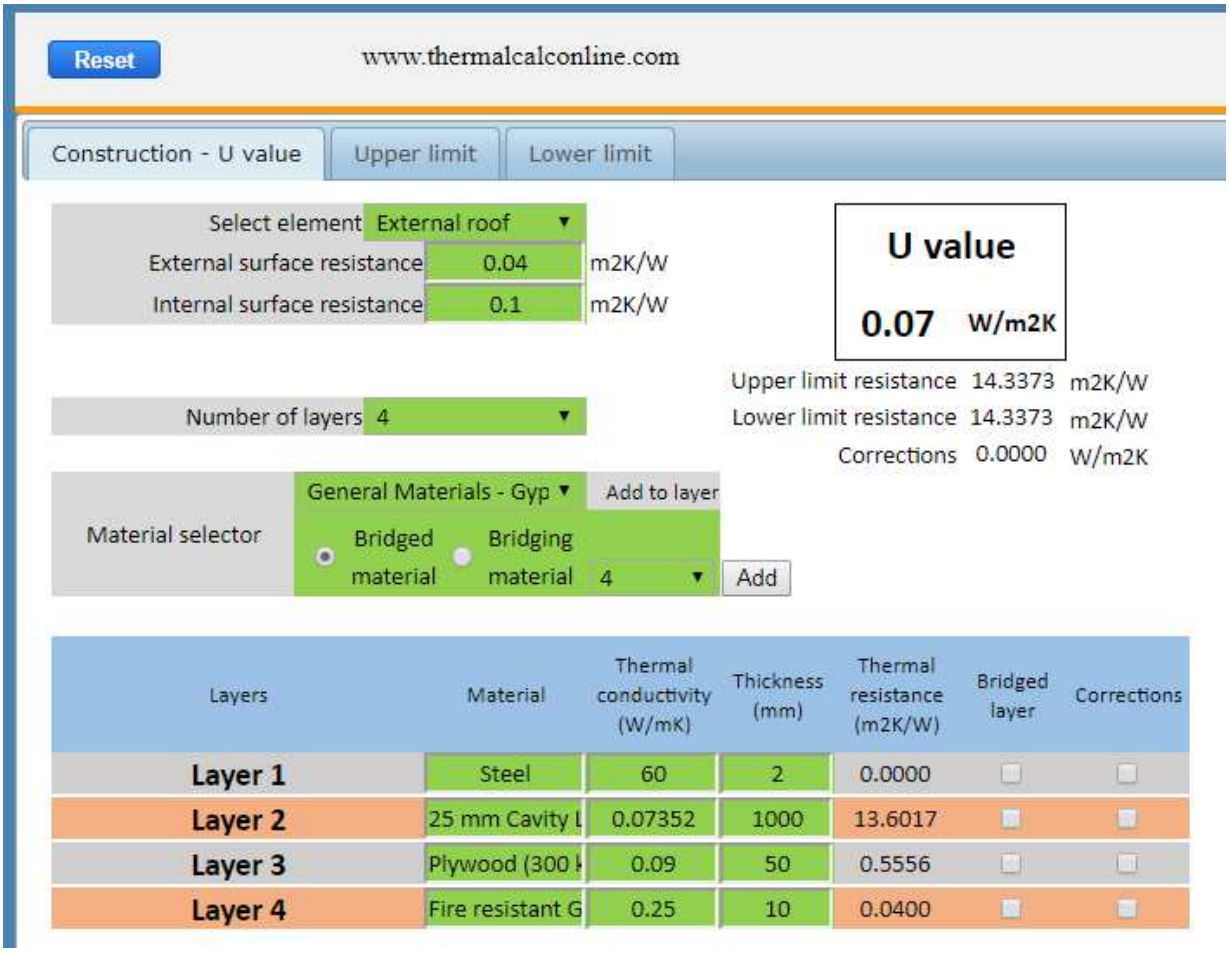
Illustration 2

Sample calculation showing U-value of overall roof assembly of 1062 mm thickness. Materials in the roof assembly include metal roof 2 mm thickness, air cavity of 1000mm thickness, plywood work of 50 mm thickness, fire resistant gypsum board false ceiling of 10mm thickness.

As per the calculator, the overall U-value of the roof assembly is 0.07 $W/m^{2o}K$ < 1 $W/m^{2o}K$

Hence the project achieves 2 points under U-value of overall Roof Assembly

Illustration 2



Source: www.thermalcalconline.com

Additional Guidance for User:

Thermal transmittance (U-value):

The thermal transmittance of U-value of a construction is defined as the quantity of heat that flows through a unit area of a building section under steady-state conditions in unit time per unit temperature difference of the air on either side of the section. It is expressed in $W/m^{2o}K$ and is given by:

$$U = \frac{1}{R_T}$$

where R_T is the total thermal resistance and is given by:

$$R_T = R_o + \frac{b_1}{K_1} + \frac{b_2}{K_2} + \ldots + \frac{b_n}{K_n} + R_i$$

where

R_o	:	air film resistance of external surface ($m^2\,^oK/W$)
R_I	:	air film resistance of internal surface ($m^2\,^oK/W$)
K_1, K_2, K_n	:	thermal conductivity of basic material ($W/m\,^oK$)
b_1, b_2, b_n	:	thickness of basic material (m)

Solar Heat Gain Coefficient (SHGC)

The SHGC is the fraction of incident solar radiation admitted through a window, both directly transmitted and absorbed and subsequently released inward. SHGC is expressed as a number between 0 and 1. The lower a window's solar heat gain coefficient, the less solar heat it transmits.

Window to Wall Ratio (WWR)

The window-to-wall ratio is the measure of the percentage area determined by dividing the building's total glazed area by its exterior envelope wall area.

Module 1 - Energy Efficiency

Indicators and point allocation

S.No.	Indicator Title	Optional / Mandatory	Points Allocation
1.1	Building Envelope – Façade Design Parameters	Optional	25
1.2	Ventilation	Optional	15
1.3	Daylighting	Optional	17.5
1.4	Artificial Lighting Efficiency	Mandatory	5
1.5	Enhanced Artificial Lighting Efficiency	Optional	9
1.6	Lifts and Escalators	Optional	3
1.7	Renewable Energy	Optional	5
1.8	Solar Hot Water Systems	Mandatory	5
1.9	Energy Metering	Optional	2
1.10	Air Conditioning System	Optional	7.5
1.11	Building Envelope – Air-conditioned space	Optional	8
	Sub-total for Energy Efficiency		**102**

Module 2: Water Efficiency

Indicators and point allocation

S.No.	Category	Optional / Mandatory	Points Allocation
2.1	Rain Water Harvesting	Mandatory	4
2.2	Efficient Plumbing Fixtures	Mandatory	3
2.3	Enhanced Efficient Plumbing Fixtures	Optional	6
2.4	Wastewater Treatment and Reuse	(i) Wastewater treatment – Mandatory (ii) Treated wastewater reuse – Optional	(i) Wastewater treatment – 6 (ii) Treated wastewater reuse – 10
2.4	Water Metering	Optional	2
Sub-total for Water Efficiency			**31**

2.1 RAINWATER HARVESTING

Mandatory Points: 4

Intent:

Reduce potable water demand and uncontrolled storm water run-off through effective rainwater management

Applicability:

This indicator is mandatory and is applicable to all buildings

Indicator Requirement:

Requirement	Scoring Scheme
Implement a rainwater harvesting system to capture 100% run-off from roof area. The rainwater harvesting system and storage calculations shall confirm to RS 187: 2013 'Rainwater harvesting systems – Code of Practice'	4 points

Documentary Evidence:

1. Rainwater harvesting system sizing calculations
2. Rainwater harvesting system schematic indicating the catchment area, piping system and storage tank
3. Photographs of the installed rainwater harvesting system; or Purchase receipt for the rainwater harvesting system (To be submitted to the building inspector during verification/inspection stage)

Sample:

Runoff volume (m^3) = Roof area (m^2) x run-off coefficient of roof x average peak month rainfall (m)

- Run-off coefficient: The proportion of rooftop rainfall that is available for collection after losses incurred from evaporation, leakage, overflow, transportation, etc. This variable is heavily impacted by rooftop material.

Run-off coefficients of typical surface types	
Tiled roof	0.95
Metal roof	0.95
Flat roof	0.95

- To arrive at average peak month rainfall, consider an average of at least last 5 years peak month rainfall

Background information of sample project:

An upcoming hospital building in Kigali in 2018, has the following characteristics

- Roof area = 1000 m^2
- 100% Metal roof whose run-off coefficient is 0.95
- Average peak month rainfall for Kigali for the last 5 years i.e, from 2014 to 2018 is 180 mm or 0.18 m

Using the above formula, Rainfall volume (m^3) = Roof area (m^2) x run-off coefficient of roof x average peak month rainfall (m)

Rainfall volume (m^3) = 1000 x 0.95 x 0.18

Rainfall volume = 171 cubic meters

The project should install rainwater harvesting system to store 171 cubic meters of run-off from roof areas to comply with the mandatory requirement.

2.2 EFFICIENT PLUMBING FIXTURES

Mandatory Points: 3

Intent:

Reduce the use of potable water by using water efficient fittings

Applicability:

This indicator is mandatory and is applicable to all buildings

Indicator Requirement:

<table>
<tr><th>Requirement</th><th>Scoring Scheme</th></tr>
<tr><td>Use water efficient plumbing fixtures (as applicable) whose flow rates meet the baseline criteria mentioned below:

<table>
<tr><th>Fixture type</th><th>Baseline Flow Rate Range</th></tr>
<tr><td>Water Closets (Full flush)</td><td>4 to 4.5 LPF</td></tr>
<tr><td>Water Closets (Half flush)</td><td>2.5 to 3 LPF</td></tr>
<tr><td>Urinals</td><td>1 to 1.5 LPF</td></tr>
<tr><td>Faucets / Taps*</td><td>4 to 6 LPM</td></tr>
<tr><td>Showerhead / Handheld spray*</td><td>7 to 9 LPM</td></tr>
<tr><td>Sink / Bib taps</td><td>6 to 8 LPM</td></tr>
</table>

* Reporting pressure for these fixtures shall be at 3 bar

LPF – Litres per flush
LPM – Litres per minute</td><td>0.5 point awarded for meeting baseline flow rate for each fixture type.

(Capped at 3 points)</td></tr>
</table>

Documentary Evidence:

1. Plumbing fixture schedules showing the types, numbers, make and model and calculation showing the percentage of proposed fixtures meeting baseline flow rate in the prescribed tabulated format shown in the sample
2. Manufacturer data sheets for plumbing fixtures indicating the flow rates along with the reporting pressure
3. Photographs of the installed plumbing fixtures; or purchase receipts of the plumbing fixtures (To be submitted to the building inspector during verification/inspection stage)

Sample:

Example of a water fitting schedule showing the numbers, types and the number of proposed fixtures meeting baseline efficiency range requirements

S.No.	**Water Fitting Type**	**Total nos. based on fitting type (T)**	**No. of fixtures meeting baseline flow rate range (A)**	**No. of fixtures not meeting baseline flow rate range (B)**	**Percentage fixtures meeting baseline flow rate range P = (A/T) x 100**	**Points Scored (0.5 point awarded for meeting baseline flow rate for each fixture type) P x 0.5**
1	Water Closets (Full flush)	50	30	20	60%	60% x 0.5 = 0.3
2	Water Closets (Half flush)	50	30	20	60%	60% x 0.5 = 0.3
3	Urinals	70	60	10	85%	85% x 0.5 = 0.425
4	Faucets / Taps*	100	100	0	100%	100% x 0.5 = 0.5
5	Showerhead / Handheld spray*	100	100	0	100%	100% x 0.5 = 0.5
6	Sink / Bib taps	30	15	15	50%	50% x 0.5 = 0.25
					Points Scored	**2.275 can be rounded of to 2.3 < 3 points (maximum points that can be scored)**

2.3 ENHANCED EFFICIENT PLUMBING FIXTURES

Optional Points: 6

Intent:

Reduce the use of potable water by using water efficient fittings

Applicability:

This indicator is optional and is applicable to all buildings

Indicator Requirement:

<table>
<tr><th>Requirement</th><th>Scoring Scheme</th></tr>
<tr><td>Use water efficient plumbing fixtures (as applicable) whose flow rates meet the baseline criteria mentioned below:

<table>
<tr><th>Fixture type</th><th>Baseline Flow Rate Range</th></tr>
<tr><td>Water Closets (Full flush)</td><td>3.5 to 4 LPF</td></tr>
<tr><td>Water Closets (Half flush)</td><td>2.5 LPF or less</td></tr>
<tr><td>Urinals</td><td>0.5 to 1 LPF</td></tr>
<tr><td>Faucets / Taps*</td><td>2 to 4 LPM</td></tr>
<tr><td>Showerhead / Handheld spray*</td><td>5 to 7 LPM</td></tr>
<tr><td>Sink / Bib taps</td><td>4 to 6 LPM</td></tr>
</table>

* Reporting pressure for these fixtures shall be at 3 bar

LPF – Litres per flush
LPM – Litres per minute</td><td>1 point awarded for meeting baseline flow rate for each fixture type.

(Capped at 6 points)</td></tr>
</table>

Documentary Evidence:

1. Plumbing fixture schedules showing the types, numbers, make and model and calculation showing the percentage of proposed fixtures meeting baseline flow rate in the prescribed tabulated format shown in the sample
2. Manufacturer data sheets for plumbing fixtures indicating the flow rates along with the reporting pressure
3. Photographs of the installed plumbing fixtures; or purchase receipts of the plumbing fixtures (To be submitted to the building inspector during verification/inspection stage)

Sample:

Example of a water fitting schedule showing the numbers, types and the number of proposed fixtures meeting baseline efficiency range requirements

S.No.	**Water Fitting Type**	**Total nos. based on fitting type (T)**	**No. of fixtures meeting baseline flow rate range (A)**	**No. of fixtures not meeting baseline flow rate range (B)**	**Percentage fixtures meeting baseline flow rate range** **P = (A/T) x 100**	**Points Scored (1 point awarded for meeting baseline flow rate for each fixture type) P x 1**
1	Water Closets (Full flush)	50	30	20	60%	60% x 1 = 0.6
2	Water Closets (Half flush)	50	30	20	60%	60% x 1 = 0.6
3	Urinals	70	60	10	85%	85% x 1 = 0.85
4	Faucets / Taps*	100	100	0	100%	100% x 1 = 1
5	Showerhead / Handheld spray*	100	100	0	100%	100% x 1 = 1
6	Sink / Bib taps	30	15	15	50%	50% x 1 = 0.5
					Points Scored	**4.55 can be rounded of to 4.6 < 6 points (maximum points that can be scored)**

2.4 WASTE WATER TREATMENT AND REUSE

Waste Water Treatment: Mandatory Points: 6

Treated Waste Water reuse: Optional Points: 10

Intent:

Treat waste water generated on-site, to avoid pollution of ground water and receiving streams through safe disposal. And use treated waste water, thereby reducing consumption of potable water

Applicability:

Waste water treatment is mandatory indicator and is applicable to all buildings. Whereas, treated waste water reuse is optional indicator and is applicable to all buildings

Indicator Requirement:

<table>
<tr><th>Requirement</th><th>Scoring Scheme</th></tr>
<tr><td>

For Wastewater Treatment:

Ensure that 100% of waste water generated in the building is treated to the discharge standards, as prescribed by Rwanda Standards Board (RSB) under RS 110:2009 'Water quality – Tolerance limits of discharged domestic wastewater'

Tolerance limits for discharged domestic wastewater

<table>
<tr><th>S.No.</th><th>Parameter</th><th>Treatment Limits</th></tr>
<tr><td>1</td><td>TDS mg/l</td><td><1500</td></tr>
<tr><td>2</td><td>TSS mg/l</td><td><50</td></tr>
<tr><td>3</td><td>pH</td><td>5-9</td></tr>
<tr><td>4</td><td>Nitrates mg/l</td><td><20</td></tr>
<tr><td></td><td>Nitrites mg/l</td><td><2</td></tr>
<tr><td></td><td>Total Nitrogen</td><td><30</td></tr>
<tr><td>5</td><td>Total Phosphorous mg/l</td><td><5</td></tr>
<tr><td>6</td><td>Temperature variation of treated water compare to ambient temperature of water °C</td><td><3</td></tr>
<tr><td>7</td><td>BOD5 mg/l</td><td><50</td></tr>
<tr><td>8</td><td>8 COD mg/l</td><td><250</td></tr>
<tr><td>9</td><td>Faecal Coliforms /100ml</td><td><400</td></tr>
<tr><td>10</td><td>Oil and grease mg/l</td><td><10</td></tr>
<tr><td>11</td><td>Chlorine mg/l</td><td><2</td></tr>
<tr><td>12</td><td>Sulphate mg/l</td><td><500</td></tr>
<tr><td>13</td><td>Color Pt-Co</td><td><200</td></tr>
</table>

</td><td>

6 points are awarded for treating 100% waste water generated on site. The treated wastewater shall meet the tolerance limits of discharged domestic wastewater as specified under RS 110:2009

</td></tr>
</table>

Note: Limits are the values not to be exceeded during periodic measurement under normal conditions. Source - RS 110:2009 **For Treated wastewater reuse:** Waste water to be treated to the reuse standards prescribed by Rwanda Standards Board (RSB)	1 point for 10% of treated water reused within the building. (Capped at 10 points)

Documentary Evidence:

For Wastewater treatment:

1. Manufacturers datasheet of the wastewater treatment plant confirming to tolerance limits of discharged domestic wastewater
2. Calculations showing the designed capacity of the wastewater treatment plant in m^3/day
3. Photographs of the installed wastewater treatment plant; or purchase receipts of the wastewater treatment system (To be submitted to the building inspector during verification/inspection stage)

For Treated Wastewater reuse:

1. Manufacturers datasheet of the wastewater treatment plant confirming to reuse standards
2. Calculations showing the following:
    a. Designed capacity of the wastewater treatment plant in m^3/day
    b. Quantity of waste water available for recycling in m^3/day
    c. Water balance chart clearly indicating how treated wastewater would be reused in the building
    d. Percentage of treated wastewater reused within the building in the prescribed tabulated format shown in the sample
3. Photographs of the installed wastewater treatment plant; or purchase receipts of the wastewater treatment system (To be submitted to the building inspector during verification/inspection stage)

Sample:

Example of an office building demonstrating the percentage of treated wastewater reused within the building

Total volume of wastewater (both greywater and blackwater) generated (litres/day)	100,000
Proposed capacity of wastewater treatment plant (litres/day)	150,000
Efficiency of wastewater treatment plant	90%

Total Volume of waste water treated & available for reuse (litres/day)	90,000
Number of working days of office building	250
Total volume of treated wastewater available annually for reuse (litres)	22,500,000

Table showing water consumption and proposed treated wastewater reuse

Consumption	Volume of Water Required Annually (litres)	Volume of Treated Wastewater Reused (litres)
Flushing	20,000,000	20,000,000
Irrigation for landscaping	15,000,000	2,500,000
Total	35,000,000	22,500,000

Total volume of water required annually (for Flushing & irrigation for landscaping) in litres = 35,000,000

Total volume of treated wastewater used annually (litres) = 22,500,000

Percentage of treated wastewater reused in the building = 22,500,000 / 35,000,000 = 64.2%

As per the scoring scheme, the building is awarded 1 point for 10% of treated wastewater reused, here the building is proposed to reuse 64.2% of treated wastewater. Hence 6.4 points are awarded.

2.4 WATER METERING

Optional Points: 2

Intent:

Promote use of private meters for better control and monitoring of water usage.

Applicability:

This indicator is optional and is applicable to all buildings

Indicator Requirement:

Requirement	Scoring Scheme
Demonstrate sub-metering for at least one of the following water use applications, as applicable: 1. Piped water supply 2. Treated waste water consumption 3. Water consumption for landscape requirements 4. Water consumption for flushing 5. Water consumption for air-conditioning cooling tower makeup 6. Any other major source of water consumption	0.5 point for sub-metering for at least one water use applications (capped at 2 points)

Documentary Evidence:

1. A narrative describing the installed water meters and respective end uses in the project.
2. Calculations showing the sub-meters installed for various water use applications in the prescribed tabulated format shown in the sample
3. Schematic drawing showing the location of water meters installed in the project.
4. Photographs of installed meters; or purchase receipts of the water meters (To be submitted to the building inspector during verification/inspection stage)

Sample:

Example of a hospital building showing various sub-meters installed

S.No.	Water use application	Sub-meter installed
1	Piped water supply	Yes
2	Treated waste water consumption	Not applicable
3	Water consumption for landscape requirements	Yes
4	Water consumption for flushing	No
5	Water consumption for air-conditioning cooling tower makeup	Not applicable

Total number of sub-meters installed = 2

Points awarded = 1 < 2 (maximum points that can be awarded)

Module 2: Water Efficiency

Indicators and point allocation

S.No.	Category	Optional / Mandatory	Points Allocation
2.1	Rain Water Harvesting	Mandatory	4
2.2	Efficient Plumbing Fixtures	Mandatory	3
2.3	Enhanced Efficient Plumbing Fixtures	Optional	6
2.4	Wastewater Treatment and Reuse	(i) Wastewater treatment – Mandatory (ii) Treated wastewater reuse – Optional	(i) Wastewater treatment – 6 (ii) Treated wastewater reuse – 10
2.4	Water Metering	Optional	2
Sub-total for Water Efficiency			**31**

Module 3: Environmental Protection

Indicators and point allocation

S.No.	Category	Optional/ Mandatory	Points Allocation
3.1	Sustainable Concrete Usage	Optional	5
3.2	Greenery Protection	Optional	10
3.3	Environment Friendly Practices	Optional	2
3.4	Low-impact Refrigerants: Zero Ozone Depletion Potential	Mandatory	2
3.5	Low-impact Refrigerants: Low Global Warming Potential	Optional	4
3.6	Segregation of Waste, Post-occupancy	Optional	2
3.7	Heat Island Mitigation	Optional	3
Sub-total for Environmental Protection			**28**

3.1 SUSTAINABLE CONCRETE USAGE

Optional Points: 5

Intent:

Encourage the adoption of concrete usage practices that are environmentally friendly and sustainable.

Applicability:

This indicator is optional and is applicable to all buildings

Indicator Requirement:

Requirement	Scoring Scheme
Concrete Usage Index (CUI) Encourage designs with efficient use of concrete for building components. Note: Concrete Usage Index (CUI) is an indicator of the amount of concrete used to construct the superstructure that includes both the structural and non-structural elements. CUI does not include the concrete used for external works and sub-structural works such as basements and foundations. CUI is defined as the volume of concrete in cubic meters needed to cast a square meter of constructed floor area. It is expressed as: Concrete Usage Index = Concrete volume in m^3 / Constructed Floor Area in m^2	Points for building CUI are awarded as below: **Building CUI (m^3/m^2)** / **Points Allocation** 0.61 - 0.70 / 1 0.51 - 0.60 / 2 0.41 - 0.50 / 3 0.31 - 0.40 / 4 0.21 - 0.30 / 5

Documentary Evidence:

1. Architectural and structural plan layout, elevation and sectional plans showing the type of structural system used, the dimensions and sizes of all the building and structural elements; and

2. Summary showing the quantity of concrete for each floor level in the prescribed tabulated format shown in worked sample. The calculation should include all the building elements as listed in the worked example and the derivation of the concrete volume should be detailed and made available for evaluation.

Sample:

Proposed development comprises a 5 Floor office block with one basement carparks and the following details:

Concrete usage for the Superstructure	**Constructed Floor Areas**
From Ground Floor = 500 m^3 **From 1st to 4th Floor = 1500 m^3**	**From Ground Floor = 600 m^2** **From 1st to 4th Floor = 2400 m^2**
Total Concrete Usage = 2000 m^3	**Total Constructed Floor Area = 3000 m^2**

Note: The concrete usage for foundation and one basement need not be included in the calculations

Concrete Usage Index (CUI) = 2000 / 3000 = 0.66 m^3/m^2

Based on the point allocation shown under scoring scheme

CUI of 0.66 m^3/m^2 falls under 0.61 - 0.7 m^3/m^2

Therefore, point scored = 1 point

3.2 GREENERY PROTECTION

Optional Points: 10

Intent:

Preserve and enhance greenery to attract biodiversity and reduce heat island effect

Applicability:

This indicator is optional and is applicable to all buildings

Indicator Requirement:

Requirement	Scoring Scheme
Preserve or Restore trees Preserve/ restore at least 20% of existing trees during construction Note: • Restoration means transplanting of existing trees	1 point for every 20% existing trees preserved or restored during construction (Capped at 5 points)
Compensatory Plantation For every uprooted tree, plant at least 10 new saplings of similar or other species within the plot boundary or outside the plot boundary, wherever permitted. Note: • For building projects located in large campuses, project boundary shall be clearly defined for indicator calculations	1 point for every 10 new saplings planted. (Capped at 5 points)

Documentary Evidence:

For Preserve or Restore trees

1. A narrative describing the strategies implemented to preserve/ restore existing trees during construction
2. Site plan indicating the location of existing trees, before construction
3. Calculations demonstrating that at least 20% of existing trees are preserved or restored in the prescribed tabulated format shown in worked example Sample 1
4. Photographs of existing trees preserved or restored

For Compensatory Plantation

1. A narrative describing the details about plantation of new saplings, for each station
2. Site plan indicating the location of existing trees, before construction

3. Calculations demonstrating that for every uprooted tree, at least 10 new saplings are planted in the prescribed tabulated format shown in worked example Sample 2
4. Landscape plan (post-construction) highlighting the location of newly planted saplings. Please provide a legend indicating the type of new plant species used.
5. Photographs of newly planted saplings

Sample 1: For Preserve or Restore trees

Proposed office development has 20 existing trees on the site. The building has the following plans:

Total existing fully-grown trees on site	20
No. of trees preserved during construction	5
No. of trees restored / transplanted to facilitate construction	5
Total number of trees preserved / restored during construction	10
No. of trees proposed to be cut	10
Percentage of trees preserved / restored during construction	(10/20) x 100 = 50%
Points scored as per the scoring scheme	2.5

Sample 2: For Compensatory Plantation

Sample calculations for the above example

Total existing fully-grown trees on site	20
No. of trees proposed to be cut	10
No. of new saplings planted (10 new plants for each uprooted tree)	100
Points scored as per the scoring scheme (1 points for every 10 new saplings, capped at 5 points)	5 (maximum points that can be scored)
In case, the project has demonstrated exemplary performance by planting more saplings, additional points will be awarded under innovation indicator	

3.3 ENVIRONMENT FRIENDLY PRACTICES

Optional Points: 2

Intent:

Encourage adoption of environment friendly practices during building construction

Applicability:

This indicator is optional and is applicable to buildings as deemed necessary by the competent authority

Indicator Requirement:

Requirement	Scoring Scheme
Compliance with Environment Impact Assessment (EIA) Report	2 points

Documentary Evidence:

1. A narrative describing the strategies implemented by the building to comply with EIA report
2. Submit photographs, wherever required to demonstrate compliance (To be submitted to the building inspector during verification/inspection stage)

Sample:

Proposed hotel development has submitted EIA report to receive building permit.

The project team has submitted a narrative describing the strategies implemented by the building to comply with EIA report along with supporting photographs. Hence, 2 points are awarded.

3.4 LOW-IMPACT REFRIGERANTS: ZERO OZONE DEPLETION POTENTIAL

Mandatory Points: 2

Intent:

Reduce the potential damage to the ozone layer caused by the release of ozone depleting substances

Applicability:

This indicator is mandatory and is applicable to all air-conditioning systems in buildings

Indicator Requirement:

Requirement	Scoring Scheme
Use refrigerants with Ozone Depletion Potential (ODP) of zero Note: Refer to the Appendix C to see the complete list of available refrigerants	2 points

Documentary Evidence:

1. Extracts from the tender specification showing the requirement for all refrigerants to have an ODP of zero
2. A list of all air-conditioning equipment's & systems indicating the type of refrigerant
3. Manufacturer datasheets of refrigerants used in air-conditioning equipment & systems

Additional Guidance to the user:

Ozone Depletion Potential (ODP)

A number that refers to the amount of ozone depletion caused by a substance. The ODP is the ratio of the impact on ozone of a chemical compared to the impact of a similar mass of chlorofluorocarbon (CFC)-11. Thus, the ODP of CFC-11 is 1.0.

3.5 LOW-IMPACT REFRIGERANTS: LOW GLOBAL WARMING POTENTIAL

Optional Points: 4

Intent:

Reduce the potential damage to the environment due to increase in global warming caused by the release of greenhouse gases.

Applicability:

This indicator is optional and is applicable to all air-conditioning systems in buildings

Indicator Requirement:

Requirement	Scoring Scheme
Use refrigerants with Global Warming Potential (GWP) of less than 50. Note: Refer to the Appendix C to see the complete list of available refrigerants	4 points

Documentary Evidence:

1. Extracts from the tender specification showing the requirement for all refrigerants to have a GWP of less than 50.
2. A list of all air-conditioning equipment's & systems indicating the type of refrigerant
3. Manufacturer datasheets of refrigerants used in air-conditioning equipment & systems

Additional Guidance to the user:

Global Warming Potential (GWP)

This is a measure of how much a given mass of greenhouse gas is estimated to contribute to global warming. It is a relative scale that compares the gas in question to that of the same mass of carbon dioxide, whose GWP is 1.0.

3.6 SEGREGATION OF WASTE, POST-OCCUPANCY

Optional Points: 2

Intent:

Facilitate segregation of waste at source to encourage reuse or recycling of materials, thereby avoiding waste being sent to landfills.

Applicability:

This indicator is optional and is applicable to all buildings

Indicator Requirement:

Requirement	Scoring Scheme
Provide separate bins to collect dry waste (paper, plastic, metals, glass, etc.,) and wet waste (organic), as applicable.	2 points

Documentary Evidence:

1. Floor plans showing the location of the recycling bins for segregation, collection and storage of different recyclable waste.
2. Photographs of dedicated waste collection bins and storage area along with signages (To be submitted to the building inspector during verification/inspection stage)

3.7 HEAT ISLAND MITIGATION

Optional Points: 3

Intent:

Minimize heat island effect to reduce negative impact on micro-climate

Applicability:

This is an optional indicator and is applicable to all buildings with metal & concrete roofs

Indicator Requirement:

<table>
<tr><th>Requirement</th><th>Scoring Scheme</th></tr>
<tr><td>For metal & concrete roofs use material with a high Solar Reflective Index (SRI) to cover at least 50% of the exposed roof area.

1. Minimum initial SRI value for low-slope roof (slope less than or equal to 1:6) – 78

2. Minimum initial SRI value for High-slope roof (slope greater than 1:6) – 29 and Maximum of 64

Notes:
For this indicator, all roof areas, including podium, covered surface parking and utility blocks, which are exposed to the sky (at and above ground level) should be considered for calculations.
Exposed roof area need not include equipment platforms, areas with solar photovoltaic panels, solar water heating systems, skylights, swimming pool, driveways, pathways, roads, play areas etc.,
SRI values of reflectance material shall be as per ASTM standards</td><td>1 point for 50% of the exposed roof area covered with material with high SRI. Point allocation is as per below:

<table><tr><th>Percentage exposed roof area covered with a high SRI material</th><th>Points</th></tr><tr><td>50%</td><td>1</td></tr><tr><td>75%</td><td>2</td></tr><tr><td>95%</td><td>3</td></tr></table></td></tr>
</table>

Documentary Evidence:

1. A narrative describing the strategies implemented to reduce heat island effect from roof areas.
2. Drawings showing exposed roof areas covered with high reflective material
3. Calculations demonstrating that at least 50% of exposed roof areas is covered with high reflective material as per prescribed format in worked sample
4. Letters from the manufacturer indicating SRI value (as per ASTM standards) of high reflective materials used in the project

5. Photographs showing exposed roof areas covered with high reflective material (To be submitted to the building inspector during verification/inspection stage)

Sample:

Proposed development comprises a 5 Floor hospital block (low-slope roof), utility block (high-slope roof) and the following details:

Roof area of hospital block (Sqm)	5000
Roof area covered by Solar Photovoltaic panels (Sqm)	500
Roof area covered by Solar Water Heating System (Sqm)	200
Roof area of utility block (Sqm)	200
Total exposed roof area, excluding roof area covered by Solar photovoltaic panels, Solar water heating system (Sqm)	5000 – (500 + 200) + 200 = 4500
Exposed roof area applied with high SRI paint (Sqm) Note: Initial SRI values are different for low-slope and high-slope roofs	3000
Percentage exposed roof area covered with a high SRI material	(3000/4500) x 100 = 66.6%
Points Scored	1 (refer scoring scheme)

Additional Guidance to the user:

Heat Island Effect - The thermal absorption by hardscape, such as dark, non-reflective pavement and buildings, and its subsequent radiation to surrounding areas. Other contributing factors may include vehicle exhaust, air conditioners and street equipment. Tall buildings and narrow streets reduce airflow and exacerbate the effect.

Solar Reflective Index (SRI) – SRI is a measure of the constructed surface's ability to stay cool in the sun by reflecting solar radiation and emitting thermal radiation. It is defined such that a standard black surface has an initial SRI of 0, and a standard white surface has an initial SRI of 100.

Module 3 - Environmental Protection
Indicators and point allocation

S.No.	Category	Optional/ Mandatory	Points Allocation
3.1	Sustainable Concrete Usage	Optional	5
3.2	Greenery Protection	Optional	10
3.3	Environment Friendly Practices	Optional	2
3.4	Low-impact Refrigerants: Zero Ozone Depletion Potential	Mandatory	2
3.5	Low-impact Refrigerants: Low Global Warming Potential	Optional	4
3.6	Segregation of Waste, Post-occupancy	Optional	2
3.7	Heat Island Mitigation	Optional	3
Sub-total for Environmental Protection			**28**

Module 4: Indoor Environmental Quality

Indicators and point allocation

S.No.	Category	Optional/ Mandatory	Points Allocation
4.1	Minimum Outdoor Fresh Air Supply – Mechanically Ventilated Spaces	Mandatory	4
4.2	Thermal Comfort – Mechanically Ventilated Spaces	Mandatory	2
4.3	Noise level	Mandatory	2
4.4	Low VOC Paints and Adhesives	Optional	2
Sub-total for Indoor Environmental Quality			**10**

4.1 MINIMUM OUTDOOR FRESH AIR SUPPLY: AIR-CONDITIONED SPACES

Mandatory Points: 4

Intent:

Provide adequate outdoor fresh air supply, to avoid pollutants affecting indoor air quality

Applicability:

This indicator is mandatory and is applicable to air-conditioned spaces

Indicator Requirement:

<table>
<tr><th>Requirement</th><th>Scoring Scheme</th></tr>
<tr><td>Demonstrate that the outdoor fresh air supply in all air-conditioned spaces meet the minimum ventilation rates, as prescribed in Table 4.11.4-3: Outdoor Air Supply Requirement for Comfort Air-Conditioning of Rwanda Building Code 2015.

Table: Outdoor Air Supply Requirement for Comfort Air-Conditioning
<table>
<tr><th>Type of Building/ Occupancy</th><th colspan="3">Minimum Outdoor Air Supply</th></tr>
<tr><th></th><th>l/s per m² floor area</th><th>m³/h per m² floor area</th><th>l/s per person</th></tr>
<tr><td>Restaurant</td><td>3.4</td><td>12.2</td><td>5.1</td></tr>
<tr><td>Dance Halls</td><td>7.0</td><td>25.0</td><td>10.5</td></tr>
<tr><td>Offices</td><td>0.6</td><td>2.0</td><td>5.5</td></tr>
<tr><td>Shops, supermarkets and department stores</td><td>1.1</td><td>3.8</td><td>5.5</td></tr>
<tr><td>Theatres and cinemas seating area</td><td>2.0</td><td>7.3</td><td>3.0</td></tr>
<tr><td>Lobbies and corridors</td><td>0.3</td><td>1.1</td><td>3.3</td></tr>
<tr><td>Concourses</td><td>1.1</td><td>4.0</td><td>3.3</td></tr>
<tr><td>Hotel guest rooms</td><td>15 L/s per room</td><td>54 m³/h per room</td><td>5.5</td></tr>
<tr><td>Primary school children and above</td><td>2.8</td><td>10.0</td><td>4.2</td></tr>
<tr><td>Childcare Centers</td><td>2.8</td><td>10.0</td><td>8.4</td></tr>
</table>
Note:</td><td>4 points</td></tr>
</table>

• Dance halls refer to night clubs. The outdoor air supply in discotheques requires 50 % more than that in dance halls; and • The use of higher outdoor air supply in hotel guest rooms should take precedence. Source: Rwanda Building Code 2015	

Documentary Evidence:

1. A narrative describing the outdoor fresh air ventilation system design implemented in the project
2. Outdoor fresh air intake calculations, for air-conditioned spaces to demonstrate compliance with the reference standard mentioned under the requirement

4.2 THERMAL COMFORT – MECHANICALLY VENTILATED SPACES

Mandatory Points: 2

Intent:

Provide good thermal comfort for all developments with air-conditioning systems to promote occupant productivity and well-being

Applicability:

This indicator is mandatory and is applicable to air-conditioned spaces

Indicator Requirement:

Requirement	Scoring Scheme
Ensure that air-conditioning systems are designed to allow for cooling load variations due to fluctuations in ambient air temperature and to maintain consistent indoor conditions for thermal comfort • Indoor temperature between 24^0C to 26^0C • Relative humidity less than 65%	2 points

Documentary Evidence:

Submit extracts of the tender specification showing the requirement to design the air-conditioning systems that would provide consistent indoor conditions for thermal comfort as stated in the above requirement.

4.3 NOISE LEVEL

Mandatory Points: 2

Intent:

Recognize that buildings are designed to control and keep the background noise in occupied spaces at levels appropriate to the intended use of the spaces and confirm to the ambient noise standards

Applicability:

This indicator is mandatory and applicable to occupied spaces and building developments

Indicator Requirement:

<table>
<tr><th>Requirement</th><th>Scoring Scheme</th></tr>
<tr><td>

(i) Noise levels inside buildings

Acoustic design and verification of the building to meet the requirements of RS 236: 2014 ‘Acoustics - Noise pollution – Tolerance limits’

Maximum acceptable noise levels inside buildings

<table>
<tr><th>S.No.</th><th>Type of building</th><th>Maximum acceptable noise levels (dB)</th></tr>
<tr><td>1</td><td>Offices</td><td>50-60</td></tr>
<tr><td>2</td><td>Dwellings (Houses and Flats)</td><td>45-55</td></tr>
<tr><td>3</td><td>Schools (Classrooms or lecture rooms)</td><td>45-50</td></tr>
<tr><td>4</td><td>Hospitals</td><td>40-50</td></tr>
</table>

Source – RS 236: 2014

(ii) Buildings to meet ambient noise standards

Buildings to meet ambient air quality standards in respect of noise as per below requirement

Ambient air quality standards in respect of noise

<table>
<tr><th rowspan="2">Area code</th><th rowspan="2">Category of Area</th><th colspan="2">Limit in dB, Max.</th></tr>
<tr><th>Day Time</th><th>Night Time</th></tr>
<tr><td>A</td><td>Industrial Area</td><td>75</td><td>70</td></tr>
<tr><td>B</td><td>Commercial Area</td><td>65</td><td>55</td></tr>
<tr><td>C</td><td>Residential Area</td><td>55</td><td>45</td></tr>
</table>

</td><td>

1 point

1 point

</td></tr>
</table>

D	Silence Zone	50	40
Source – RS 236: 2014			

Documentary Evidence:

For Noise levels inside buildings

1. Extracts of the tender specification showing the requirement to design the occupied space within the acceptable noise levels; and
2. A report of the detailed analysis and recommendations from acoustic consultant/ qualified person on how the designed ambient sound levels can be met where applicable.

For Buildings to meet ambient noise standards

1. Submit a signed declaration letter by the building owner stating that the building confirms to the ambient noise standards during the entire lifetime of the building

4.4 LOW VOC PAINTS AND ADHESIVES

Optional Points: 2

Intent:

Minimize airborne contaminants, mainly from inside sources to promote a healthy indoor environment

Applicability:

This indicator is optional and applicable to all indoor paints and adhesives used in the building

Indicator Requirement:

<table>
<tr><th>Requirement</th><th>Scoring Scheme</th></tr>
<tr><td>(a) Use of low volatile organic compounds (VOC) paints

VOC limits for paints

<table>
<tr><th>Type of Paint</th><th>VOC limit (g/L less water)</th></tr>
<tr><td>Flat paint</td><td>50</td></tr>
<tr><td>Non-flat paint</td><td>100</td></tr>
<tr><td>Primer or undercoat</td><td>100</td></tr>
<tr><td>Floor coating</td><td>100</td></tr>
<tr><td>Anti-corrosive or Anti-rust</td><td>250</td></tr>
<tr><td>Clear Wood Finish: Varnish</td><td>350</td></tr>
<tr><td>Clear Wood Finish: Lacquer</td><td>550</td></tr>
<tr><td>Reflective Wall Coating</td><td>50</td></tr>
<tr><td>Reflective Roof Coating</td><td>100</td></tr>
</table>

(b) Use of low VOC adhesives

<table>
<tr><th>Type of Adhesive</th><th>VOC limit (g/L less water)</th></tr>
<tr><td>Glazing adhesives</td><td>100</td></tr>
<tr><td>Ceramic tile adhesives</td><td>65</td></tr>
<tr><td>Drywall and panel adhesives</td><td>50</td></tr>
<tr><td>Wood substrata adhesives</td><td>30</td></tr>
</table>
</td><td>Extent of Coverage: At least 90% of the total internal wall areas
1 point

Extent of Coverage: At least 90% of the applicable areas
1 point</td></tr>
</table>

Wood flooring adhesives	100
HVAC duct insulation	850
Indoor Carpet adhesives	50
Multipurpose construction adhesives	70

Documentary Evidence:

For low VOC Paints

1. A list of low or no VOC content paints & coatings (make & model) used in the project interiors, along with the VOC content (in g/L, less water).
2. Test certificate or manufacturer letters (addressed to the building) indicating the VOC content (in g/L, less water) of the paints & coatings sourced.

For low VOC Adhesives

1. A list of low or no VOC content adhesives (make & model) used in the project interiors, along with the VOC content (in g/L, less water).
2. Test certificate or manufacturer letters (addressed to the building) indicating the VOC content (in g/L, less water) of the adhesives sourced.

Module 4 - Indoor Environmental Quality Indicators and point allocation

S.No.	Category	Optional/ Mandatory	Points Allocation
4.1	Minimum Outdoor Fresh Air Supply – Mechanically Ventilated Spaces	Mandatory	4
4.2	Thermal Comfort – Mechanically Ventilated Spaces	Mandatory	2
4.3	Noise level	Mandatory	2
4.4	Low VOC Paints and Adhesives	Optional	2
Sub-total for Indoor Environmental Quality			**10**

Module 5: Innovation and Other Green Features

Indicators and point allocation

	Category		Optional / Mandatory	Points Allocation
	5.1	Innovation	Optional	10
	5.2	Universally Accessible Building	Mandatory	9
		Sub-total for Innovation and Other Green Features		**19**

5.1 INNOVATION

Optional Points: 10

Intent:

Encourage the use of green features that are innovative and have positive environmental impact on energy efficiency, water efficiency, environmental protection and indoor environmental quality of the buildings

Applicability:

This indicator is optional and applicable to all buildings

Indicator Requirement:

Requirement	Scoring Scheme
(a) Innovation: Features that could be quantified and positive environmental impact demonstrated. Examples: • Vertical greenery systems on the East and West Façade to reduce heat gain in the building • Vegetation to cover 50% of the exposed roof area • Drip irrigation system with rain and soil moisture sensors • Occupancy sensors for corridors, staircases, toilets, conference rooms and closed cabins • Photoelectric sensors to maximize daylighting • Sun pipes for natural lighting • Building Management System to monitor and control the following systems: Air-conditioning management system; Lighting management system; Renewable energy management system; Elevator management system; Fresh air monitoring system; CO_2 control and monitoring system • High frequency ballasts in luminaires **(b) Exemplary Performance:** The project is eligible for exemplary performance, if the design and / or construction measures greatly exceed	2 points for each innovation or exemplary performance. (Capped at 10 points)

the requirements of the Rwanda green building minimum compliance requirements.

List of indicators eligible for exemplary performance:

Number	Indicator	Exemplary performance threshold
1.7	Renewable Energy	≥ 6% On-site Renewable Energy generation
3.1	Sustainable Construction Materials (b) Concrete Usage Index	CUI ≤ 0.20 m^3/m^2
3.2	Greenery Protection (b) Compensatory Plantation	Compensatory plantation beyond indicator requirement

Documentary Evidence:

For Innovation

1. Narrative on innovative features implemented in the building
2. Technical product information (including drawings and supporting documents) of the green features
3. Quantified evidences on the potential environmental benefits that the features can bring to the development.

For Exemplary Performance

1. Calculations indicating the next incremental threshold percentage achieved in the respective indicator.

5.2 UNIVERSALLY ACCESSIBLE BUILDING

Mandatory Points: 9

Intent:

Ensure that the building is accessible to differently abled and elderly

Applicability:

This indicator is mandatory and applicable to all publicly accessible buildings

Requirement:

Design the building to meet the following requirements of differently abled and elderly as specified in 'Facilities for Persons with Disabilities in Public Buildings' published by RHA in November 2011 1. Appropriately designed preferred car park spaces having an easy access to the main entrance or closer to the lift lobby. 2. Non-slippery ramps, with handrails 3. Lifts to be equipped with wide access doors, control buttons at convenient height, Braille and audio assistance for visually impaired people. 4. Seating area near lift lobbies 5. Uniformity in floor level for hindrance-free movement in common areas & exterior areas. 6. Restrooms (toilets) in common areas designed for differently abled people. 7. Main walkways / pathways with adequate width in exterior areas. 8. Visual warning signage in common areas & exterior areas. 9. Any other innovative feature to meet the needs of differently abled persons	1 point awarded for every feature provided (capped at 9 points)

Documentary Evidence:

1. Narrative on features implemented to meet the requirements of differently abled persons
2. Submit Architectural drawings and supporting documents for features, as applicable
3. Submit photographs of facilities provided for differently abled (To be submitted to the building inspector during verification/inspection stage)

Module 5: Innovation and Other Green Features Indicators and point allocation

S.No.	Category	Optional / Mandatory	Points Allocation
5.1	Innovation	Optional	10
5.2	Universally Accessible Building	Mandatory	9
	Sub-total for Innovation and Other Green Features		**19**

Section 3 – Green Building Minimum Compliance System Implementation Plan

Lead: Rwanda Housing Authority (RHA)						
S/N	**Program**	**Objective**	**Indicators**	**Stakeholders**	**Minimum Budget**	**Timeline**
1	Development of Standards	• To avail missing standards in accordance to Standards needs assessment done for easy implementation of the green building minimum compliance system	Availability of Reports and Standards	**RSB** RHA WASAC REG	10,000,000 Frw (Recurrent Line)	6 months
2	Testing of Indicators	• To assess sampled project designs and existing buildings against the indicators to determine enforcement feasibility of retrofitting possibility • To avail a compiled report and a strategy on how realistic retrofitting could be achieved	Availability of a Report and a Strategy	**RHA** OSCs GGGI RIA & IER WASAC REG REMA	30,000,000 Frw (Recurrent Line)	2 months
3	Development of Calculators	• To provide calculators to ease assessment of compliance with the green building minimum compliance system for projects concerned	Availability of Calculators/ Spreadsheets	**GGGI** RHA BCA RwGBO	10,000,000 Frw (Recurrent Line)	4 months
4	Digitization of implementation of the green building minimum compliance system	• To develop forms and checklist to use in Bpmis • To integrate the green building minimum compliance system requirements in the Building Permit Management Information System (Bpmis)	Green building minimum compliance system integrated in the Bpmis	**RHA** ROPL OSCs RIA & IER	5,000,000 Frw (Recurrent Line)	2 months
5	Training of Trainers	• To undertake capacity building need assessment • To identify potential Trainers across the country • To conduct training for Trainers on all indicators	Increased number of Skilled Trainers	**RHA** OSCs GGGI RwGBO BCA	10,000,000 Frw (Recurrent Line)	1 month

Lead: Rwanda Housing Authority (RHA)						
S/N	**Program**	**Objective**	**Indicators**	**Stakeholders**	**Minimum Budget**	**Timeline**
6	Training of One Stop Centers	• To deploy calculators and other enforcement tools in all Districts One Stop Centers (OSCs) • To train One Stop Centers on how to assess permit applications against the green building minimum compliance system	Number of Capacitated OSCs	**RHA** OSCs GGGI RwGBO BCA	60,000,000 Frw (Recurrent Line)	11 months
7	Training of Professionals/ Practitioners	• To train all professionals/ practitioners in the construction industry on Green Building Minimum Compliance System • Certification for all engineers and architects operating in the constructions of buildings of category 4&5	Number of Capacitated Professionals	**RHA,** OSCs GGGI, RwGBO, BCA RIA & IER	20,000,000 Frw (Recurrent Line)	1 week
8	Massive awareness Campaign	• To develop communication tools such as TV spots, booklets with illustrations, Radio dialogues, etc • To collaborate with high learning institutions and the ministry of education for easy dissemination • To ensure the green building minimum compliance system is introduced in Architecture and Engineering teaching programs/curricula	Number of awareness tools developed and implemented or disseminated	**RHA** OSCs GGGI RwGBO BCA RIA & IER RBA MINALOC	30,000,000 Frw (Recurrent Line)	3 months
9	Leading by Example through total compliance with the green building minimum compliance system for public	• To make sure that all public construction projects are in total compliance with the green building minimum compliance system • To initiate retrofitting or upgrading of existing Government buildings in compliance with selected enforceable indicators • To seek housing services such as rental office spaces, hotel services, etc…. from better ranked private buildings	Number of buildings compliant with the green building minimum compliance system and the number of existing buildings	**RHA** DISTRICTS GGGI	60,000,000,000 Frw (Development Line)	12 months

Lead: Rwanda Housing Authority (RHA)						
S/N	**Program**	**Objective**	**Indicators**	**Stakeholders**	**Minimum Budget**	**Timeline**
	construction projects		retrofitted or upgraded			
10	Performance Ranking & Labelling for occupied buildings	• To label buildings as per the minimum compliance ranking • To advocate for special incentives for better ranked buildings	Number of private and public buildings ranked	**RHA** RwGBO BANKS INSURANCE GGGI FONERWA	50,000,000 Frw (Recurrent Line)	Continuous
11	Enforcement, Monitoring and Evaluation	• To enforce the provisions of the green building minimum compliance system through permitting and inspection services • To monitor the level of compliance through performance audits • To evaluate the actual impact of the green building minimum compliance system on protection of the environment for amendments aiming at optimizing green building practices	Percentage of compliant buildings and number of existing retrofitted or upgraded public buildings per annum.	**RHA** GGGI RwGBO	50,000,000 Frw (Recurrent Line)	Continuous

Section 4: Appendices

Appendix A

AIR-CONDITIONING SYSTEMS (BASELINE)

Minimum Energy Efficiency Requirements for water cooled Chillers

Chiller Capacity (kWr)	Coefficient of Performance (COP)	Test Procedure
<260	4.7	AHRI Standard 551/591
≥260 & <530	4.9	
≥530 & <1050	5.4	
≥1050 & <1580	5.8	
≥1580	6.3	
Coefficient of Performance (COP) – cooling: The ratio of the rate of heat removal to the rate of energy input, in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions		

Minimum Energy Efficiency Requirements for air cooled Chillers

Chiller Capacity (kWr)	Coefficient of Performance (COP)	Test Procedure
<260	2.8	AHRI Standard 551/591
≥260 & <530	3.0	
Coefficient of Performance (COP) – cooling: The ratio of the rate of heat removal to the rate of energy input, in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions		

Minimum Requirements for Unitary Air Conditioners

Cooling Capacity (kWr)	Fixed (RSEER)	Variable (RSEER)
≤16	3.50	4.0
Rwanda Seasonal Energy Efficiency Ratio (RSEER): The seasonal cooling energy efficiency developed using ISO CSPF with a Rwanda outdoor temperature distribution. *Source: Rwandan Ministry of Environment, National Cooling Strategy, December 2018*		

Minimum Requirements for Split Air Conditioners

Cooling Capacity (kWr)	Fixed (RSEER)	Variable (RSEER)
≤4.5	3.80	4.60
>4.5 & ≤ 9.5	3.50	4.30
>9.5 & ≤ 16 kW	3.20	3.90
Rwanda Seasonal Energy Efficiency Ratio (RSEER): The seasonal cooling energy efficiency developed using ISO CSPF with a Rwanda outdoor temperature distribution.		

Source: Rwandan Ministry of Environment, National Cooling Strategy, December 2018

Minimum Efficiency Requirements for VRF Air conditioners

		For heating or cooling or both	
Type	**Size Category (kWr)**	**Energy Efficiency Ratio (EER)**	**Test Procedure**
VRF Air Conditioners, Air cooled	<40	3.28	ANSI/AHRI Standard 1230
	≥40 & <70	3.26	
	≥70	3.02	
Energy Efficiency Ratio (EER): the ratio of net cooling capacity in kW to total rate of electric input in watts under design operating conditions			

Appendix-B

TYPICAL U-VALUES OF SOME BUILDING COMPONENTS

	U-value [W/m²K]
Brick	
Single skin, 105 mm	3.28
Single skin, 220 mm	2.26
Single skin, 335 mm	1.73
Single skin, 105 mm plastered	3.02
Single skin, 220 mm plastered	2.14
Single skin, 335 mm plastered	1.79
Cavity, 275 mm plastered	1.47
same, with 25 mm EPS in cavity	0.72
same, with 40 mm EPS in cavity	0.55
same, with 50 mm EPS in cavity	0.47
Brick 105, cavity, 100 low concrete block, Low plaster	0.92
same + 25 mm EPS	0.55
same but 50 mm EPS	0.4
Concrete block solid 200, plasterboard	1.83
same, but foil-backed plasterboard	1.4
same, but 25 cavity, 25 EPS, plasterboard	0.7
same, but lightweight concrete	0.69
same, but foil-backed plasterboard	0.61
same, but 25 cavity, 25 EPS, plasterboard	0.46

Concrete block, hollow, 200 mm, ins. plasterboard	2.42
Concrete, dense, cast, 150 mm	3.48
same + 50 mm woodwool slab, plastered	1.23
same, but lightweight plaster	1.15
Concrete, dense, cast, 200 mm	3.1
same + 50 mm woodwool slab, plastered	1.18
same, but lightweight plaster	1.11
Concrete, precast panel, 75 mm	4.28
same + 25 cavity + 25 EPS + plasterboard	0.84
Concrete, precast, 75 + 25 EPS + 150 Low concrete	0.58
same, but 50 mm EPS	0.41
Brick/block veneers	
Brick 105 + cavity (frame) + plasterboard	1.77
same, but foil-backed plasterboard	1.35
same with 25 mm EPS or glass fibre	0.78
same with 50 mm EPS or glass fibre	0.5
same, 25 EPS + foil-backed plasterboard	0.69
Block 100 + cavity (frame) + plasterboard	1.57
same, but foil-backed plasterboard	1.24
same with 25 mm EPS or glass fibre	0.74
same with 50 mm EPS or glass fibre	0.48
same, 25 EPS + foil-backed plasterboard	0.66
Windows	
Wood frame, single 6 mm glass	5
Wood frame, double glazing	2.9
Metal frame, single 6mm glass	6
same, but discontinuous frame	5.7
Metal frame, double glazing	3.6
same, but discontinuous frame	3.3
Vinyl frame, double (clear + clear) glazing	2.8
same, but bronze + clear glass	2.8
same, but argon filled clear + clear glazing	1.9
same, but argon filled low-e clear + clear	1.7

Insulated vinyl frame, krypton fill, triple clear glass	1.9
Insulated vinyl frame, krypton fill, triple (2 low-e) glass	0.8
Roof glazing single 6 mm glass	6.6
Roof glazing double glazing	4.6
Horizontal daylight + skylight, ventilated	3.8
same but unventilated	3
Flat roofs	
150 concr. slab, plastered, 75 screed + asphalt	1.8
same, but lightweight concrete	0.84
25 timber deck, bit. felt, plasterboard ceiling	1.81
same + 50mm EPS	0.51
10 fibrous cement deck, 13 fibreboard, asphalt, fibrous cement ceiling	1.5
50 ww, 13 screed, 20 asph, plasterboard ceiling	1
13 fibreboard, 20 asph, 10 foil-back plasterboard	1.2
Metal deck, 25 EPS, bitumenous felt	1.1
same + 13 fibreboard + plasterboard ceiling	0.73
same, but 50 mm EPS	0.48
Pitched roofs	
Corrugated fibrous cement sheet	4.9
same + attic + plasterboard ceiling	2.58
same + 50 mm EPS or glass fibre	0.55
Tiles, sarking + attic + plasterboard ceiling	2.59
same + 50 mm EPS or glass fibre	0.54
Tiles, sarking, 25 timber ceiling (sloping)	1.91
same + 50 mm EPS or glass fibre	0.51
Metal sheet (corrugated or profiled)	7.14

Source: UN-HABITAT Sustainable Building Design for Tropical Climates Principles and Applications for Eastern Africa, August 2014

Appendix-C

LIST OF REFRIGERANTS WITH ODP AND GWP VALUES

Type	Product – R Number	ODP	GWP
Chlorofluorocarbons (CFC)	11	1	4680
	12	1	10720
	114	0.94	9800
	500	0.605	7900
	502	0.221	4600
Hydrochlorofluorocarbons (HCFC)	22	0.04	1780
	123	0.06	77
Hydrofluorocarbons (HFC)	23	0	14800
	32	0	675
	134a	0	1430
	404A	0	3922
	407A	0	2107
	407C	0	1774
	407F	0	2088
	417A	0	2346
	422A	0	3143
	422D	0	2729
	423A	0	2280
	424A	0	2440
	427A	0	2138
	428A	0	3607
	434A	0	3245
	437A	0	1805
	438A	0	2265
	442A	0	1888
	507A	0	3985
	508B	0	13396
	MO89	0	3805
HFO	1234yf	0	4
	1234ze	0	6
Natural	170	0	6
	290	0	3
	600a	0	3
	717	0	0
	744	0	1
	1150	0	4
	1270	0	2