DESIGN REFERENCE GUIDE

RESIDENTIAL BUILDING & LANDED HOME

Version 4.0, January 2026

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1. About GreenRE

GreenRE Sdn Bhd is a wholly owned subsidiary of the Real Estate and Housing Development Association (REHDA). The GreenRE rating tool has been developed for the purposes as mentioned herein and may be subject to updating and/or modification in the future.

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2. Introduction

The GreenRE assessment scheme was established in 2013 and is a recognised green building rating system tailored for the tropical climate. GreenRE sets parameters and establishes indicators to guide the design, construction and operation of buildings towards increased energy effectiveness and enhanced environmental performance.

The intent of this Design Reference Guide for Residential Buildings and Landed Homes (referred to as "this Guideline") is to establish environmentally friendly practices for the planning, design, construction and operation of buildings, which would help to mitigate the environmental impact of built structures.

This Guideline is not intended to abridge safety, health, environmental or related requirements contained in other applicable laws, codes or policies administered by relevant authorities. Where there is a conflict between a requirement of this Guideline and such other regulations affecting the design, construction and operation of the project, the building regulations shall take precedence.

As part of this guideline, the following definitions apply:

Landed Home – Residential bungalows, villas, terrace houses etc.
High-rise Residential – Residential flats or condominiums.

3. Revision Log

Revision	Description	Date Effective
1.1	Launched for Implementation	1st June 2013
1.2	Revised version of Implementation	1st June 2014
2.0	Revised version of Implementation	1st June 2015
3.0	Revised version of Implementation	1st October 2015
3.1	Revised version of Implementation	15th March 2018
3.2	Revised version of Implementation	15th February 2021
3.2	Revised version of Implementation	1st September 2021
3.3	Revised version of Implementation	June 2023
3.3	Revised version of Implementation	January 2024
4.0	Revised version of Implementation	February 2026

4. GreenRE Assessment Stages

The GreenRE Residential Building & Landed Home certification process is as follows:

Application

- Submittal of application with relevant supporting documents for certification upon strategic inception of New Facilities design.

Pre-Assessment

- A pre-assessment can be conducted (optional) to give the project team a better understanding of the criteria and evaluation of the certification level sought. This should be performed upon selection of suitable design option to allow teams to identify and maximise opportunities at the earliest stages of the project.

Actual Assessment

- Actual assessment to be conducted once the design and documentary evidences (e.g. approved plan) are ready. After the actual assessment, our assessors will review the documents submitted. Assessment process includes design and documentary reviews to verify if the project meets:
  i. The intents of the criteria
  ii. The pre-requisite requirement for GreenRE Bronze, Silver, Gold and Platinum rating where applicable.
- Provisional Certificate will be issued upon completion of this stage.

Site Verification

- Site verification to be conducted upon project completion.
- Final Certificate will be issued upon completion of this stage.

5. GreenRE Residential Building Rating System

OVERVIEW:

The GreenRE rating system is divided into six (6) sections as follows:

Part 1 – Energy Efficiency: This category focuses on the approach that can be used in the building design and system selection to optimise the energy efficiency of buildings.

Part 2 – Water Efficiency: This category focuses on the selection of fittings and strategies enabling water use efficiency during construction and building operation.

Part 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.

Part 4 – Indoor Environmental Quality: This category focuses on the design strategies that would enhance the indoor environmental quality which include air quality, thermal comfort, acoustic control, and daylighting.

Part 5 – Other Green Features: This category focuses on the adoption of green practices and new technologies that are innovative and have potential environmental benefits.

Part 6 – Carbon Emission of Development: This category focuses on the use of carbon calculator to calculate the carbon footprint of the development.

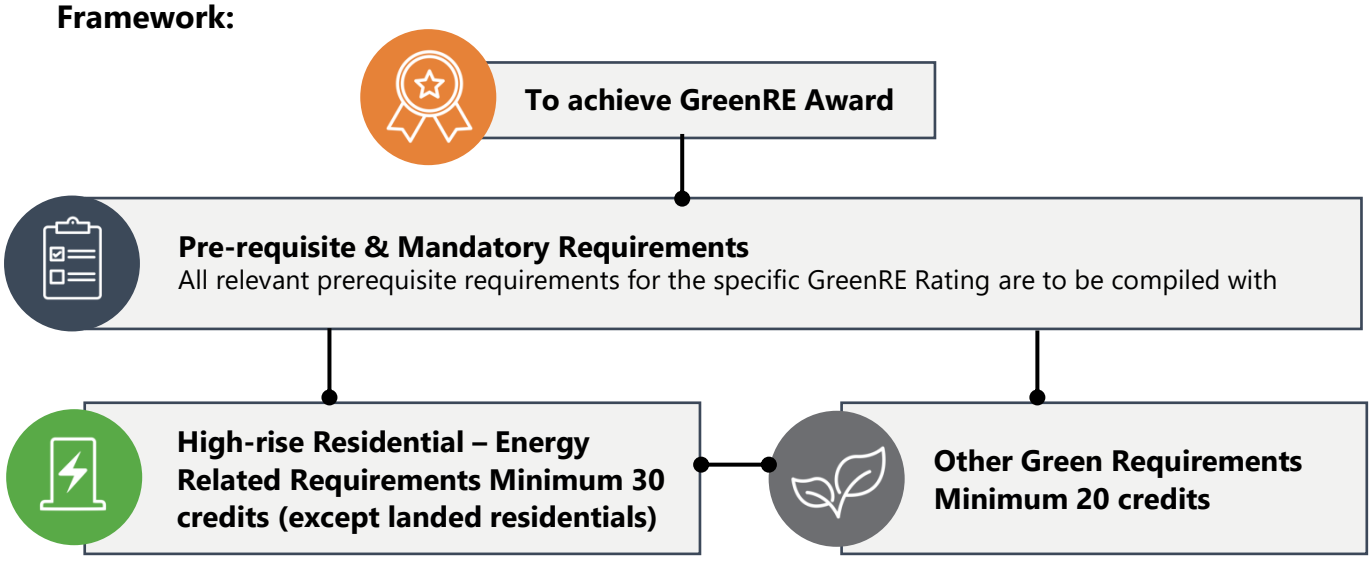
These environmental impact categories are broadly classified under two main groups namely (I) Energy Related Requirements and (II) Other Green Requirements.

Energy Related Requirements consist of Part 1- Energy Efficiency where credits are allocated for the various energy efficient designs, practices and features used. For High-rise residential buildings a minimum of 30 credits must be obtained from this group to be eligible for certification. For landed homes, there is no minimum credit requirement under this category for certification eligibility. The number of credits achievable for this group is capped at 50 credits (exclude 15 bonus credits that are obtainable under RES 1-10 – Renewable Energy).

Other Green Requirements consist of Part 2 – Water Efficiency; Part 3 – Environmental Protection; Part 4 – Indoor Environmental Quality; Part 5 – Other Green Features and Part 6 – Carbon Emission of Development. Credits are allocated for the water efficient features, environmentally friendly design practices, innovative green features used and carbon footprint of development. A minimum of 20 credits must be obtained from this group to be eligible for certification. The number of credits achievable for this group is also capped at 50 credits.

The maximum GreenRE score achievable for a project is capped at 100 credits and this does not include 15 bonus credits that are obtainable under Energy Related Requirements if a project uses renewable energy sources. The credit scored for renewable energy provision shall not result in a double grade jump in GreenRE rating (i.e. from GreenRE Bronze or Silver to Gold or Platinum)

Framework:



Elective Requirement for Energy Improvement (Combination of the following items to meet required credits)

PART 1 - ENERGY EFFICIENCY

RES 1-1 Thermal Performance of Building Envelope – RETV
RES 1-2 Naturally Ventilated Design and Energy Efficient Cooling System
RES 1-3 Daylighting
RES 1-4 Artificial Lighting
RES 1-5 Ventilation in Carparks
RES 1-6 Domestic Hot Water System
RES 1-7 Lifts
RES 1-8 Cool Hardscaped Areas
RES 1-9 Energy Efficient Features
RES 1-10 Renewable Energy

Elective Requirement for Other Areas (Combination of the following items to meet required credits)

PART 2 - WATER EFFICIENCY

RES 2-1 Water Efficient Fittings
RES 2-2 Water Usage Monitoring
RES 2-3 Irrigation System and Landscaping

PART 3 – ENVIRONMENTAL PROTECTION

RES 3-1 Sustainable Construction
RES 3-2 Sustainable Products
RES 3-3 Greenery Provision
RES 3-4 Environmental Management Practice
RES 3-5 Green Transport
RES 3-6 Stormwater Management
RES 3-7 Community Connectivity

PART 4 - INDOOR ENVIRONMENTAL QUALITY

RES 4-1 Noise Level
RES 4-2 Indoor Air Pollutants
RES 4-3 Waste Disposal
RES 4-4 Indoor Air Quality in Wet Areas

PART 5 – OTHER GREEN FEATURES

RES 5-1 Green Features & Innovations

PART 6 – CARBON EMISSION OF DEVELOPMENT

RES 6-1 Carbon Emission of Development

CREDIT ALLOCATION:

Category		Credits Allocations	
(I) Energy Related Requirements		**High-Rise**	**Landed**
Minimum 30 credits	**Part 1: Energy Efficiency**		
	RES 1-1 Thermal Performance of Building Envelope -RETV	15	22
	RES 1-2 Naturally Ventilated Design and Energy Efficient Cooling	22	22
	RES 1-3 Daylighting	6	6
	RES 1-4 Artificial Lighting	8	4
	RES 1-5 Ventilation in Carparks	2	0
	RES 1-6 Domestic Hot Water System	3	3
	RES 1-7 Lifts	1	1
	RES 1-8 Cool Hardscape Areas	2	2
	RES 1-9 Energy Efficient Features	7	7
	RES 1-10 Renewable Energy	15	15
	Category Score for Part 1 – Energy Efficiency	**81 (Max)**	**82 (Max)**
(II) Other Green Requirements			
Minimum 20 credits	**Part 2: Water Efficiency**		
	RES 2-1 Water Efficient Fittings	8	8
	RES 2-2 Water Usage Monitoring	1	0
	RES 2-3 Irrigation System and Landscaping	3	3
	Category Score for Part 2 – Water Efficiency	**12**	**11**
	Part 3: Environmental Protection		
	RES 3-1 Sustainable Construction	10	10
	RES 3-2 Sustainable Products	10	10
	RES 3-3 Greenery Provision	8	8
	RES 3-4 Environmental Management Practice	10	10
	RES 3-5 Green Transport	5	5
	RES 3-6 Stormwater Management	3	3
	RES 3-7 Community Connectivity	1	1
	Category Score for Part 3 – Environmental Protection	**47**	**47**
	Part 4: Indoor Environmental Quality		
	RES 4-1 Noise Level	1	1
	RES 4-2 Indoor Air Pollutants	2	2
	RES 4-3 Waste Disposal	1	0
	RES 4-4 Indoor Air Quality in Wet Areas	2	2
	Category Score for Part 4: Indoor Environmental Quality	**6**	**5**
	Part 5: Sustainable Practices and Green Innovation		
	RES 5-1 Green Features & Innovations	7	7
	Category Score for Part 5: Other Green Features	**7**	**7**
	Part 6: Carbon Emission of Development		
	RES 6-1 Carbon Emission of Development	3	3
	Category Score for Part 6 – Carbon Emission of Development	**3**	**3**
	GreenRE Score:	**156 (Max)**	**157 (Max)**

6. GreenRE Residential Building Rating System Scoring

			
Score: 91 and above	Score: 86 to ≤ 90	Score: 76 to ≤ 85	Score: 50 to ≤ 75
GreenRE Platinum	**GreenRE Gold**	**GreenRE Silver**	**GreenRE Bronze**

7. GreenRE Residential Building Rating System Criteria

PRE-REQUISITE

Building envelope design with Residential Envelope Transmittance Value (RETV) computed based on the methodology and guides stipulated in the Code on Envelope Thermal Performance for Buildings, BCA, and this GreenRE Design Reference Guide.

GreenRE Bronze & Silver	RETV of 25 W/m^2 or lower
GreenRE Gold	RETV of 22 W/m^2 or lower
GreenRE Platinum	RETV of 20 W/m^2 or lower

To be eligible for GreenRE Platinum rating,

Option 1:

To perform ventilation simulation modelling and achieve minimum 60% of the selected typical dwelling units with good natural ventilation by demonstrating a wind velocity of 0.40 m/s. Common areas like staircases and lobbies (excluding those that are in basement areas) are to be designed as naturally ventilated spaces.

Assistance from ceiling fan is allowable to improve the thermal comfort of a space whereby ventilation simulation shall prove that unassisted ventilation (NV) complies with the minimum requirement of 0.14 m/s wind velocity

Option 2:

Achieve ≥ 16 credits under RES 1-2 (a) Option 2 (i) and (ii)

For provision of energy efficient cooling system, 100% of air-conditioners and/or mechanical ceiling fans used in all dwelling units and common area must be energy labelled minimum Suruhanjaya Tenaga 3-star (or equivalent) and above.

For Gold and Platinum projects, prescribed system efficiency of air-conditioners used in all dwelling units and common areas must be energy labelled minimum Suruhanjaya Tenaga 5-star (or equivalent).

Note (1): Fulfilment of pre-requisite for air-conditioners without point scoring is allowed if the requirement for the air conditioned is included in building user guide for all dwelling spaces and common areas

For Gold and Platinum projects, provision of system efficiency of mechanical ceiling fans used in all dwelling units and common areas must be energy labelled minimum Suruhanjaya Tenaga 4-star (or equivalent) and above.

Note (2): Fulfilment of pre-requisite for ceiling fans without point scoring is allowed if the requirement for the ceiling fans is included in building user guide for all dwelling spaces and common areas

Calculation of Energy Usage Index (EUI) for common area for high-rise and landed home (gated and guarded) only.

Minimum score under RES 2-1 Water Efficient Fittings

GreenRE Gold	≥ 6 credits
GreenRE Platinum	≥ 8 credits

RES 2-1 Water Efficient Fittings - To demonstrate reduction of potable water usage by 10% from baseline.

Minimum score under RES 3-1 Sustainable Construction

GreenRE Gold	≥ 3 credits
GreenRE Platinum	≥ 5 credits

Minimum score under RES 3-2 Sustainable Products

GreenRE Gold	≥ 3 credits
GreenRE Platinum	≥ 4 credits

RES 3-3 Site inventory analysis and carbon sequestration calculation.

RES 3-4 Provision of Building User Guide and Sustainable Operation and Management Guideline.

RES 3-4(a) Environmental Management Plan (EMP) during construction.

RES 3-4(i) Provision of facilities or recycling bins for collection and storage of different recyclable waste such as paper, glass, plastic etc and establish the Waste Management Route and Provide recycler details.

RES 6-1(a) & (b) & (c) Calculation of operational and embodied carbon

The roof of residential buildings shall not have a thermal transmittance (U-Value) greater than that tabulated in table below.

Roof Weight Group	Maximum U-Value (W/m^2K)
Light (Under 50 kg/m^2)	0.4
Heavy (Under 50 kg/m^2)	0.6

Part 1

Energy Efficiency

Part 1 – Energy Efficiency

RES 1-1 THERMAL PERFORMANCE OF BUILDING ENVELOPE - RETV	GREENRE CREDITS
For High-rise Residential and Landed Homes Enhance overall thermal performance of building envelope to minimise heat gain thus reducing the overall cooling load requirement. Baseline: Maximum permissible RETV = 25W/m^2 *Prerequisite Requirement:* *GreenRE Bronze & Silver - RETV of 25 W/m^2 or lower* *GreenRE Gold - RETV of 22 W/m^2 or lower* *GreenRE Platinum - RETV of 20 W/m^2 or lower* Note: Where the residential block consists of retails units. The façade area for the retails units to be considered in the RETV calculation.	3 credits for every reduction of 1 W/m^2 in RETV from the baseline. Credits scored = 75 - [3 x (OTTV)] where RETV ≤ 25 W/m^2 (Up to 15 credits)
For Landed Homes	
Lightweight roof U-value ≤ 0.35W/m^2K / Heavyweight roof U-value ≤ 0.50W/m^2K **OR**	2 credits
Lightweight roof U-value ≤ 0.30W/m^2K / Heavyweight roof U-value ≤ 0.40W/m^2K **OR**	3 credits
Lightweight roof U-value ≤ 0.25W/m^2K / Heavyweight roof U-value ≤ 0.30W/m^2K	4 credits (Up to 4 credits)
and / or Provision of hardscape roof that is finished with materials / finishes with Solar Reflectance Index (SRI) values of 40 **OR** provision of green roof to reduce local heat island effect.	

• 25% of the roof area	1 credit
• 50% of the roof area	2 credits
• 75% of the roof area	3 credits (Up to 3 credits)
RES 1-2 NATURALLY VENTILATED DESIGN AND ENERGY EFFICIENT COOLING SYSTEM	**GREENRE CREDITS**
a. Dwelling Unit Indoor Comfort Enhance building design to achieve good natural ventilation for better indoor comfort or through the use of better efficient air-conditioners if needed.	
 **Option 1 – Ventilation Simulation Modelling and Analysis** Use of ventilation simulation modelling and analysis or wind tunnel testing to identify the most effective building design and layout to achieve good natural ventilation for all unit types. <u>*Prerequisite Requirement:*</u> *GreenRE Platinum - Minimum 60% of the selected typical dwelling units with good natural ventilation by demonstrating a wind velocity of 0.40 m/s. Common areas are to be designed as naturally ventilated spaces. Assistance from ceiling fan is allowable to improve the thermal comfort of a space whereby ventilation simulation shall prove that unassisted ventilation (NV) complies with the minimum requirement of 0.14 m/s wind velocity* **OR**	0.2 credits for every percentage of typical units with good natural ventilation Credits scored = 0.2 x (% of typical units with good natural ventilation) (Up to 20 credits) **OR**
 **Option 2 – Ventilation Design (without the use of ventilation simulation modeling) and Energy Efficient Cooling System** i. Air flow within Dwelling Units	
• <u>Building layout design</u>: Proper design of building layout that utilises prevailing wind conditions to achieve adequate cross ventilation.	0.5 credits for every 10% of units with window opening facing north and south directions Credits scored = 0.5 x (% of units/10)

• Dwelling unit design: Good ventilation in indoor units through sufficient openings	0.5 credits for every 10% of living rooms and bedrooms design with true cross ventilation Credits scored = 0.5 x (% of rooms/10) (Up to 10 credits)
ii. Encourage the use of better energy efficient cooling system to minimise energy consumption. Provision of air-conditioning system Use of air-conditioners that are certified under Energy Commission (Suruhanjaya Tenaga) or equivalent.	Extent of coverage: 100% of energy efficient cooling systems used in all dwelling units are energy labelled. 4-Star: 4 credits 5-Star: 8 credits
and / or Provision of mechanical ceiling fan Use of ceiling fan as the mechanical cooling system. *Prerequisite requirement:* *GreenRE Gold / GreenRE Platinum: Mechanical ceiling fan with ST 4-star rating or equivalent* *Prerequisite requirement:* *GreenRE Gold / GreenRE Platinum: Air-conditioners with ST 5-star rating or equivalent*	4-Star: 8 credits 5-Star: 10 credits (Capped at 10 credits)
b. Natural Ventilation in Common Areas Design for natural ventilation in following common areas:	Extent of coverage: At least 80% of the applicable areas
For High-rise Residential	
• Lift lobbies and corridors	1 credit
• Staircases	1 credit
For Landed Homes	
• Management Office & Guardhouse	1 credit
• Club House	1 credit

<table>
<tr><th>RES 1-3 DAYLIGHTING</th><th>GREENRE CREDITS</th></tr>
<tr><td>Encourage design that optimizes the use of effective day lighting to reduce energy use for artificial lighting.</td><td></td></tr>
<tr><td>a. Use of daylight simulation analysis or any relevant calculations to verify that 50% or more of all habitable spaces achieve adequate daylight illuminance levels as specified in MS 2680:2017. (i.e daylight factor above 2.0%)</td><td><table><tr><th>Percentage of Habitable Spaces with Adequate Ambient Lighting Level</th><th>Credits Allocation</th></tr><tr><td>50% - 75%</td><td>1</td></tr><tr><td>76% - 90%</td><td>2</td></tr><tr><td>>90%</td><td>3</td></tr></table>(Up to 3 credits)</td></tr>
<tr><td><u>For High-rise Residential</u></td><td></td></tr>
<tr><td>b. Daylighting in the following common areas:</td><td>Extent of coverage: At least 80% of the applicable areas</td></tr>
<tr><td>• Lift lobbies and corridors</td><td>1 credit</td></tr>
<tr><td>• Staircases (non-bomba only)</td><td>1 credit</td></tr>
<tr><td>• Carparks</td><td>1 credit</td></tr>
<tr><td><u>For Landed Homes</u></td><td></td></tr>
<tr><td>• Management Office</td><td>1 credit</td></tr>
<tr><td>• Club House</td><td>1 credit</td></tr>
<tr><td>• Guardhouse</td><td>1 credit</td></tr>
<tr><td>Note:
a. Simulation or suitable daylight calculation is necessary for occupied space and common area to achieve the minimum daylight factors required.
b. For common areas, proper control of artificial lighting is required to maximise harvested daylight.</td><td></td></tr>
</table>

RES 1-4 ARTIFICIAL LIGHTING	GREENRE CREDITS
For High-rise Residential Encourage the use of energy efficient lighting in common areas to minimise energy consumption from lighting usage. Baseline: Luminance level stated in MS 1525:2019.	0.15 credits for every percentage improvement in the lighting power budget. Credits scored = 0.15 x (% improvement) (Up to 8 credits)
For Landed Homes Encourage the use of energy efficient lighting in common areas to minimize energy consumption from lighting usage. Note: *a. Applicable for landed home projects with common areas, e.g.: club-house, management office etc.* *b. Street lighting to be excluded*	0.1 credits for every percentage improvement in the lighting power budget. Credits scored = 0.1 x (% improvement) (Up to 4 credits)

RES 1-5 VENTILATION IN CARPARKS	GREENRE CREDITS
For High-rise Residential Encourage the use of energy efficient design and control of ventilation systems in car parks.	
a. Car park spaces that are fully naturally ventilated.	Naturally ventilated carparks – 2 credits
b. CO sensors are used to regulate the demand for mechanical ventilation (MV) Note: Where there is a combination of different ventilation modes adopted for car park design, the credits scored under this requirement will be prorated accordingly. Note: • Not applicable for Landed Homes	Credits scored based on the mode of mechanical ventilation provided Fume extract – 1 credit MV with or without supply – 0.5 credits (Up to 2 credits)

RES 1-6 DOMESTIC HOT WATER SYSTEM	GREENRE CREDITS
Use of innovative domestic hot water heating system:	
a. Gas water heaters or energy efficient heat pump water heaters	2 credits
b. Solar water heaters	3 credits (Up to 3 credits)

RES 1-7 LIFTS	GREENRE CREDITS
Encourage the use of lift with energy efficient features such as sleep mode or regenerative features or motorless lift.	1 credit

RES 1-8 COOL HARDSCAPE AREAS	GREENRE CREDITS
All hardscaped non-roof areas are to be finished with materials or finishes with a Solar Reflective Index (SRI) value of 29 or more.	
• ≥ 50% of non-roof hardscaped area	1 credit
• ≥ 75% of non-roof hardscaped area	2 credits
Note: The area of application for % calculation of hardscape material SRI will be for the ground floor site ONLY.	

RES 1-9 ENERGY EFFICIENT FEATURES	GREENRE CREDITS
Encourage the use of energy efficient features that are innovative and have positive environmental impact in term of energy saving.	
a. Use of energy efficient equipment or product that are certified by approved local certification body (i.e ST 5-star rated appliances)	Extent of coverage: At least 90% of the applicable equipment type or product 0.5 credits for each eligible certified equipment or product (Up to 2 credits)

b. Use of the following energy efficient features: • Heat recovery devices • Thermal Insulation • Calculation of EUI for common areas. • Provision of vertical greenery systems. • Provision of features to facilitate windows being kept open at night and during adverse weather.	2 credits for high impact item 1 credit for medium impact item 0.5 credits for low impact item (Up to 5 credits)
RES 1-10 RENEWABLE ENERGY	**GREENRE CREDITS**
a. Provision of renewable energy	
<u>For High-rise Residential</u> Encourage the use of renewable energy sources in buildings such as solar energy.	3 credits for every 1% replacement of electricity (based on annual electricity consumption exclude household's usage) by renewable energy And / or 3 credits for every 10% of roof area utilized for solar panels (Up to 15 credits)
<u>For Landed Homes</u> Encourage the use of renewable energy sources in landed homes such as solar energy.	3 credits for every 5% replacement of electricity by renewable energy (per house unit) (Up to 15 credits) Or
b. For building where solar panels are not installed, provide solar panel installation ready roof. Appropriate roof pitch, static loads, mounting system, and roof access to be considered.	1 credit
	Note: The credits scored for renewable energy provision shall not result in a double grade jump in GreenRE rating (i.e. from GreenRE Bronze to Gold or Silver to Platinum).
PART 1 – ENERGY EFFICIENCY CATEGORY SCORE:	Sum of GreenRE credits obtained from RES 1-1 to 1-10

Part 2

Water Efficiency

Part 2 – Water Efficiency

RES 2-1 WATER EFFICIENCY FITTINGS	GREENRE CREDITS
Encourage the use of water efficient fittings that are certified under the Water Efficiency Products Labelling Scheme (WEPLS). • Basin taps and mixers • Flushing cistern • Showerhead, Shower taps and mixers • Sink/bib taps and mixers • Urinals and urinal flush valve *Note:* • At least 90% of each fitting type must be rated to be able to score for the credits <u>Prerequisite requirement:</u> GreenRE Gold ≥ 6 credits GreenRE Platinum ≥ 8 credits <u>Prerequisite requirement:</u> To demonstrate reduction of potable water usage by 10% over the baseline	Credits scored based on the number and water efficiency rating of the fitting type used (Up to 8 credits)

Rating Based on WEPLS		
Efficient*	Highly Efficient**	Most Efficient***
0.5 credits	**1 credits**	**2 credits**

RES 2-2 WATER USAGE MONITORING	GREENRE CREDITS
Provision of private meters to monitor the major water usage such as irrigation, swimming pools and other water features. *Note:* • Not applicable for the landed home	1 credit

RES 2-3 IRRIGATION SYSTEM AND LANDSCAPING	GREENRE CREDITS
Provision of suitable systems that utilities rainwater or recycled water for landscape irrigation and use of plants that require minimal irrigation to reduce potable water consumption.	

a. Provision of a rainwater harvesting tank to reduce potable water usage for irrigation by 30%, with submetering installed for monitoring the reduction	Extent of Coverage: At least 50% of the landscape areas are served by the system 1 credit
b. Use of automatic water efficient irrigation system with rain sensor.	1 credit
c. Use of drought tolerant plants that require minimal irrigation.	Extent of Coverage: At least 50% of the landscape areas 1 credit
PART 2 – WATER EFFICIENCY CATEGORY SCORE:	Sum of GreenRE credits obtained from RES 2-1 to 2-3

Part 3

Environmental Protection

Part 3 – Environmental Protection

RES 3-1 SUSTAINABLE CONSTRUCTION	GREENRE CREDITS
Encourage recycling and the adoption of building designs, construction practices and materials that are environmentally friendly and sustainable.	
a. Use of sustainable and recycled materials Green Cements with approved industrial by-product (such as Ground Granulated Blast Furnace Slag (GGBS), silica fume, fly ash) to replace Ordinary Portland Cement (OPC) for super-structural works.	
b. Concrete Usage Index (CUI) Encourage more efficient concrete usage for building components.	

% Replacement of OPC by approved industrial by-products	Credits Allocation
10	1
20	2
30	3
40	4
≥50	5

(Up to 5 credits)

Project CUI (m3/m2)	Credits Allocation
≤ 0.70	1
≤ 0.60	2
≤0.50	3
≤0.40	4
≤0.35	5

(Up to 5 credits)

Prerequisite Requirement:
Minimum score under RES 3-1:
GreenRE Gold ≥ 3 credits
GreenRE Platinum ≥ 5 credits

RES 3-2 SUSTAINABLE PRODUCTS	GREENRE CREDITS
a. Promote use of environmentally friendly products that are certified by approved local or international certification bodies and are applicable to non-structural and architectural related building components.	<table><tr><th>Extent of use of environmentally friendly product</th><th>Weightage for Credits Allocation</th></tr><tr><td>Low Impact</td><td>0.5</td></tr><tr><td>Medium Impact</td><td>1</td></tr><tr><td>High Impact</td><td>2</td></tr></table> Credits scored will be based on the extent of coverage and impact. (Up to 8 credits)
b. Reuse Salvaged Materials Salvage or reuse construction materials for 2% of building materials based on the total material cost (extracted from the bill of quantities).	1 credit
c. Recycled Content Encourage the utilisation and use of recycled content material so that the total of post-consumer recycled content plus half of the pre-consumer content constitutes at least 10% based on the total material cost.	1 credit
<u>Prerequisite Requirement:</u> *Minimum score under RES 3-2:* *GreenRE Gold ≥ 3 credits* *GreenRE Platinum ≥ 4 credits*	

RES 3-3 GREENERY PROVISION	GREENRE CREDITS
Encourage greater use of greenery and restoration of existing trees to reduce heat island effect.	

For High-rise Residential

a. Green Plot Ratio (GnPR) is calculated by considering the 3D volume covered by plants using the Leaf Area Index (LAI).

Note:

- To include site inventory analysis on greenery pre-development and calculation of carbon sequestration of greenery post development.

GnPR	Credits Allocation
1.0 to < 2.0	1
2.0 to < 3.0	2
3.0 to < 4.0	3
4.0 to < 5.0	4
5.0 to < 6.0	5
≥ 6.0	6

For Landed Homes

b. Provision of greenery area within non-built-up area of each dwelling:

• 50% of non-built-up area as greenery area	1 credit
• 60% of non-built-up area as greenery area	2 credits
• 75% non-built-up area as greenery area	3 credits (Up to 3 credits)

Note: Roof gardens can be considered part of green landscape area requirement.

c. Additional green space over open space requirement by local authorities (overall masterplan):

• 15% green space	1 credit
• 20% green space	2 credits
• 25% green space	3 credits (Up to 3 credits)

Note: For single residence projects, credits for 3-3(b) can be prorated up to 6 credits.

For High-rise Residential and Landed Homes	
d. Restoration of trees on site, conservation, or relocation of existing trees on site. (at least 20%)	1 credit
e. Provision of compost bins to recycle organic waste to meet at least 30% of landscape fertilizer needs.	1 credit
RES 3-4 ENVIRONMENTAL MANAGEMENT PRACTICE	**GREENRE CREDITS**
Encourage the adoption of environmentally friendly practices during construction and building operation.	
a. Implement effective environmentally friendly programmes including monitoring and setting targets to minimise energy use, water use and construction waste during construction stage and include the following practices: • To record the electrical consumption during the construction stage and hence, minimise energy usage by on-site utilities. • Appointment of safety, health and environment officer. • To prepare an Environmental Management Plan and conduct a complete Erosion Sedimentation Control Plan (ESCP). • To prepare a Construction Waste Management Plan. • To include commitment to recycle and/or salvage 50% of the volume of non-hazardous construction debris. • Provide at least the minimum level of sanitation/safety facilities for construction workers. • Use a low-flow flushing system and efficient fitting tap in the construction site office/ showroom. • Provision of the Rainwater Harvesting System and the strategies of rainwater. • Develop and implement and IAQ Management plan for Construction.	1 credit

b. Main builder that has good track records in the adoption of sustainable, environmentally friendly, and considerate practices during construction.	1 credit
c. Building quality is assessed and passed under the Quality Assessment System (QLASSIC) or Construction Quality Assessment System (QONQUAS) or Building Quality Assessment System (BuildQUAS).	1 credit
d. To perform IBS content scoring based on CIDB IBS scoring scheme.	1 credit for IBS score ≥ 50% 2 credits for IBS score ≥ 70%
e. Developer, main builder, M&E consultant and architect are ISO 14000 certified.	0.25 credit each (Up to 1 credit)
f. Project team comprises Certified GreenRE Accredited Professional (GREAP) / Green Mark Accredited Professional (GMAP)	1 credit
g. Provision of building users' guide with details of the environmentally friendly facilities and features within the building and their uses in achieving the intended environment performance during building operation.	1 credit
h. Provision of Sustainable Operation and Management Guideline (SOMG) and a briefing to the building management team.	1 credit
i. Provision of facilities or recycling bins at each block of development for collection and storage of different recyclable waste such as paper, glass, plastic etc.	1 credit
RES 3-5 GREEN TRANSPORT	**GREENRE CREDITS**
Promote environmentally friendly transport options and facilities to reduce pollution from individual car use.	

a. Good access (<800m walking distance) to public transport networks such as MRT/LRT stations or bus stops.	1 credit
b. Provision of covered walkway to facilitate connectivity and the use of public transport.	1 credit
c. Provision of infrastructure for electric charging stations to at least 10% of available parking spaces. For landed homes, provide to all units.	1 credit
d. Provision of electric vehicle charging stations and priority carparking bays within the development. For landed home, electric vehicle charging stations to be provided at the common area.	Extent of coverage: Minimum 1 number priority carparking bay for every 100 carparking bays. EV chargers – 1 for every 200 carparking bays. (Cap at 3) 1 credit
e. Provision of covered / sheltered bicycles parking bays with rack / bar. Not applicable for the landed home	Credits scored based on the number of bicycle parking bays provided. 1 credit for the provision of ≥ 10% ×number of dwelling units 0.5 credits for the provision ≥ 5% × number of dwelling units

RES 3-6 STORMWATER MANAGEMENT	GREENRE CREDITS
Provision of infiltration features or design features for new development and redevelopment to control quantity of stormwater run-off Encourage the treatment of stormwater runoff through provision of infiltration or design features before discharge to public drains to control quality of stormwater run-off through compliance to MSMA.	Reduce post development stormwater peak discharge rate and quantity from exceeding pre-development peak discharge rate and quantity: 5 - 15% - 1 credit 16 - 25% - 2 credits > 25% - 3 credits (Up to 3 credits)

RES 3-7 COMMUNITY CONNECTIVITY	GREENRE CREDITS
Encourage development in urban area with existing infrastructure to minimise the use of private mode of transportation. Basic Services include, but are not limited to: • Bank • Beauty • Laundry • Day care • Fire Station • Hardware • Convenience/ Grocery • School • Clinic • Library • Police station • Park • Restaurant	1 credit can be scored for project located within 1km (walking distance) of at least 10 Basic Services.
PART 3–ENVIRONMENTAL PROTECTION CATEGORY SCORE:	Sum of GreenRE credits obtained from RES 3-1 to 3-7

Part 4

Indoor Environmental Quality

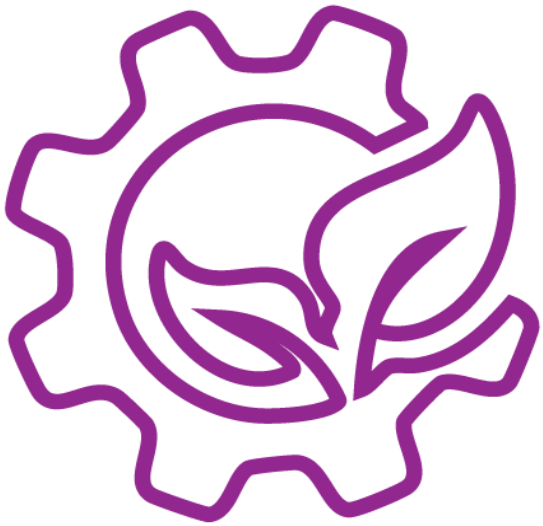
Part 4 – Indoor Environmental Quality

RES 4-1 NOISE LEVEL	GREENRE CREDITS
Building is designed to achieve ambient internal noise level as specified: • 55 dB (6am – 10pm) L_{Aeq} • 45 dB (10pm – 6am) L_{Aeq}	1 credit

RES 4-2 INDOOR AIR POLLUTANTS	GREENRE CREDITS
Minimise airborne contaminants, mainly from inside sources to promote a healthy indoor environment.	
a. Use of low volatile organic compounds (VOC) paints certified by approved local/international certification body.	Extent of Coverage: At least 90% of the total internal wall areas 1 credit
b. Use of environmentally friendly adhesives certified by approved local/ international certification body.	Extent of Coverage: At least 90% of the applicable areas 1 credit

RES 4-3 WASTE DISPOSAL	GREENRE CREDITS
For High-rise Residential Minimise airborne contaminants from waste by locating refuse chutes or waste disposal area at open ventilation areas such as service balconies or common corridors. *Note: Not applicable for landed home*	1 credit

RES 4-4 INDOOR AIR QUALITY IN WET AREAS	GREENRE CREDITS
Provision for adequate natural ventilation and day lighting in wet areas i.e. kitchens, bathroom and toilets *Note: When there are residential units with open layout (No partition between living and kitchen), and the living area with the provision of air conditioning unit, kitchen not allowed to be considered as natural ventilation spaces.*	Credits scored based on the % of applicable areas with such provision 2 credits for more than 90% of all applicable areas. 1 credit for at least 50% to 90% of all applicable areas. (Up to 2 credits)
PART 4 – INDOOR ENVIRONMENTAL QUALITY CATEGORY SCORE:	Sum of GreenRE credits obtained from RES 4-1 to 4-4

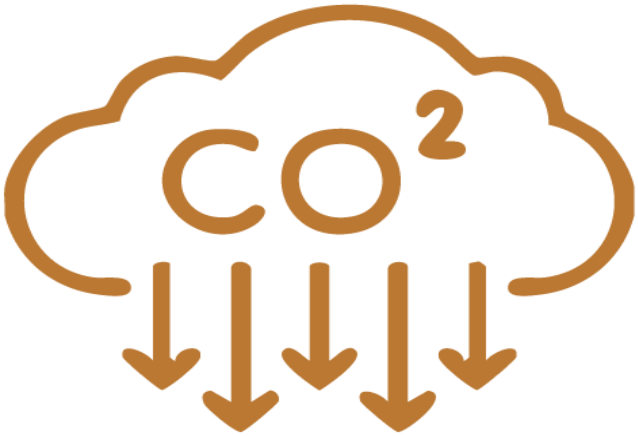


Part 5

Other Green Features

Part 5 – Other Green Features

RES 5-1 GREEN FEATURES & INNOVATIONS	GREENRE CREDITS
Encourage the use of green features that are innovative and have positive environment impact.	
Examples: • Self-cleaning facade system • Integrated basin/cistern pedestal system • Grey water recycling system • Dual chute system • Calculation of Concrete Usage Index (CUI) • Conservation of existing building structure • Water efficient washing machines with "Good" rating and above. • Etc.	2 credits for high impact item 1 credit for medium impact item 0.5 credit for low impact item (Up to 7 credits)
PART 5 – OTHER GREEN FEATURES CATEGORY SCORE:	Sum of GreenRE credits obtained from RES 5-1



Part 6

Carbon Footprint of Development

Part 6 – Carbon Footprint of Development

RES 6-1 CARBON EMISSION OF DEVELOPMENT	GREENRE CREDITS
a. Recognise the carbon emission based on operational carbon footprint computation of the building comprising energy [B6] and water consumption [B7].	1 credit
b. Calculation of product stage embodied carbon based on following building materials [A1-A3]: • concrete • steel • bricks • cement • metal / aluminium	0.5 credit
c. Calculation of construction stage embodied carbon [A4-A5]	0.5 credit
d. Reduction from reference embodied carbon (for Ready Mix Concrete, Cement, Steel Reinforcement, Bricks, Metal & Aluminium)	>10% 0.5 credit >30% 1 credit
Part 6 – CARBON EMISSION OF DEVELOPMENT CATEGORY SCORE:	Sum of GreenRE credits obtained from RES 6-1

GreenRE Score (Residential Building & Landed Home)

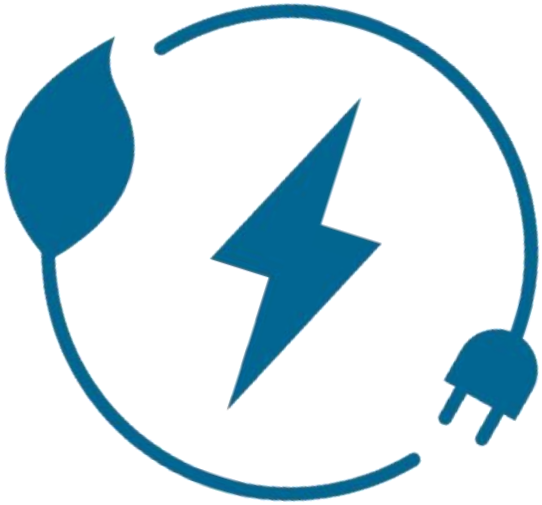
GreenRE Score (RES) = ∑Category score [(Part 1-Energy Efficiency) +
(Part 2-Water Efficiency) +
(Part 3-Environmental Protection) +
(Part 4-Indoor Environmental Quality) +
(Part 5-Other Green Features) +
(Part 6-Carbon Emission of Development)]

Where:

Category Score for Part 1≥ 30 credits (High-rise Residential) **or** Part 1 no minimum scoring (Landed Homes) and

Σ Category score for Part 2 to Part 6 ≥ 20 credits

Energy Related Requirements



Part 1 – Energy Efficiency

RES 1-1 Thermal Performance of Building Envelope – RETV

RES 1-2 Naturally Ventilated Design and Energy Efficient Cooling System

RES 1-3 Daylighting

RES 1-4 Artificial Lighting

RES 1-5 Ventilation in Carparks

RES 1-6 Domestic Hot Water System

RES 1-7 Lifts

RES 1-8 Cool Hardscaped Areas

RES 1-9 Energy Efficient Features

RES 1-10 Renewable Energy

RES 1-1 THERMAL PERFORMANCE OF BUILDING ENVELOPE – RETV

OBJECTIVES

Enhance overall thermal performance of building envelope to minimise heat gain thus reducing the overall cooling load requirement.

APPLICABILITY

Applicable to all type of residential buildings; high-rise and landed home

BASELINE STANDARD

For all Residential Buildings

Maximum permissible RETV = 25 W/m^2
(RETV stands for Residential Envelope Transmittance Value.)

The computation of RETV shall be based on the methodology specified in the Code on Envelope Thermal Performance for Building issued by BCA.

For Landed Homes Only

Lightweight roof U-value shall be ≤ 0.4W/m^2K / Heavyweight roof U-value shall be ≤ 0.6 W/m^2K as stipulated in MS 2680:2017. Due to higher roof area to building envelope area ratio for landed homes heat gain through roof takes on greater importance.

Note: Where the residential block consists of retails units. The façade area for the retail units needs to be considered in the RETV calculation.

REQUIREMENTS

For all Residential Buildings

Up to 15 credits can be scored for building envelope with better thermal performance than the baseline standard:

3 credits for every reduction of 1 W/m^2 in RETV from the baseline.

Credits scored = 75 – [3 x (RETV)] where RETV ≤ 25 W/m^2

Only external façade of the dwelling spaces (i.e. living, dining, study, and bedroom) are to be considered. Portion of the dwelling space external façade facing corridor and exposed to the direct sunlight shall be included. External façade of kitchen and toilets are NOT included in the RETV.

Refer to BCA Code on Envelope Thermal for building for appropriate solar correction factor specific for RETV

For developments consisting of more than one residential building, the weighted average of the RETVs based on the façade areas of these buildings shall be used as the basis for credits allocation.

That is:

$RETV_{Weighted\ average} = \sum (RETV_{bldg} \times A_{bldg}) / A_{devt}$

Where:

$RETV_{bldg.}$ = RETV for a residential building (W/m^2)

A_{bldg} = Summation of all façade areas that enclose all living rooms, dining rooms, study rooms, and bedrooms of a residential building. (m^2)

A_{devt} = Summation of total applicable façade areas of all residential buildings within the development (m^2) (i.e. $\sum A_{bldg}$)

For Landed Homes Only

Up to 4 credits can be scored for improvement in roof U-value beyond baseline requirement of MS 2680:2017.

Up to 3 credits can be scored for provision of cool hardscape roof area.

PREREQUISITE REQUIREMENTS

GreenRE Bronze	RETV of 25 W/m^2 or less
GreenRE Silver	RETV of 25 W/m^2 or less
GreenRE Gold	RETV of 22 W/m^2 or less
GreenRE Platinum	RETV of 20 W/m^2 or less

DOCUMENTARY EVIDENCES

- Site plan.

- Architectural elevation drawings showing the composition of the different façade or wall systems that are relevant for the computation of RETV.
- Architectural plan layouts and elevation showing the living rooms, dining rooms, study rooms and bedrooms.
- Glazing specification showing the U-value, SC value and VLT.
- Window and door schedules.
- Detailed area (m^2) tabulation of fenestration and wall for every façade.
- Calculation of U-value for all type of external walls.
- Calculation of U-value for roof.
- Calculation of the Shading Coefficient (SC2) for external shading device.
- Technical specifications showing SRI value of hardscape roof.
- Roof layout with demarcation of hardscape roof or green roof.
- RETV calculation for each facing wall and its summary.

REFERENCES

Code on Envelope Thermal Performance for Building issued by BCA.

WORK EXAMPLE 1-1

Example 1

RETV = 22 W/m^2
Credits scored = 75 – [3 x (RETV)]
= 75 – [3 x (22)]
= 9 credits

Therefore, credits scored should be 9 credits

Example 2

RETV = 19 W/m^2
Credits scored = 75 – [3 x (RETV)]
= 75 – [3 x (19)]
= 18 credits > 15 credits (Max)

Therefore, credits scored should be 15 credits (Max)

Example 3

A proposed building development comprises three residential building blocks. The individual RETV of the each residential computed are as follows:

$RETV_{bldg1}$ = 20 W/m^2 A_{bldg}= 4000 m^2
$RETV_{bldg2}$ = 25 W/m^2 A_{bldg}= 3600 m^2
$RETV_{bldg3}$ = 19 W/m^2 A_{bldg}= 5000 m^2

A_{devt}= 4000 + 3600 + 5000
= 12600 m^2

Therefore;

$$RETV_{\text{Weighted average}} = \sum (RETV_{bldg} \times A_{bldg}) / A_{devt}$$

$$= \frac{(RETV_{bldg1} \times A_{bldg1}) + (RETV_{bldg2} \times A_{bldg2}) + (RETV_{bldg3} \times A_{bldg3})}{A_{devt}}$$

$$= \frac{(20 \times 4000) + (25 \times 3600) + (19 \times 5000)}{12600}$$

$$= 21.03 \text{ W/m}^2$$

Credits scored = 75 - [3 X (RETV)]
= 75 – [3 X (21.03)]
= 11.91 credits

Note: Refer to the Code on Envelope Thermal Performance for Buildings, BCA for more detailed examples on how to compute the RETV.

RES 1-2 NATURALLY VENTILATED DESIGN AND ENERGY EFFICIENT COOLING SYSTEM

OBJECTIVES

Enhance building design to achieve good natural ventilation for better indoor comfort or using better efficient air-conditioners if needed.

APPLICABILITY

Applicable to all dwelling units within the development.

BASELINE STANDARD

1-2 (a) Option 1

Ventilation simulation modelling and analysis shall be based on the methodology specified in Appendix B – Ventilation Simulation Methodology and Requirements.

1-2 (a) Option 2(ii)

As specified under the Energy Commission (Suruhanjaya Tenaga) for air-conditioners and/or mechanical cooling fans.

REQUIREMENTS

1-2 (a) Dwelling Unit Indoor Comfort

For Option 1 – Ventilation Simulation Modelling and Analysis

Up to 20 credits can be scored for the use of ventilation simulation modelling & analysis or wind tunnel testing to identify the most effective building design and layout to achieve good natural ventilation for all unit types.

Simulation is to be conducted in accordance with the GreenRE Appendix B: Ventilation Simulation methodology and Requirements

All typical dwelling unit types should be included in the ventilation simulation (up to maximum of 5 types). If there are more than 5 typical dwelling unit types, the selection of the units for simulation will be based on extent of coverage that is the five typical dwelling units with the greatest number of units.

To add the ceiling fan requirement in the CFD

The units are deemed to have good natural ventilation if the area-weighted average wind velocity within the unit is not less than 0.40 m/s based on the ventilation simulation analysis.

The percentage of units achieving good natural ventilation is given by:

$$\frac{\sum(\text{No. of Selected Units for Each Layout} \times \text{Area-Weighted Average Wind Velocity}) \times 100\%}{\text{Total Number of Selected Units} \times 0.4\text{m/s}}$$

0.2 credit for every percentage of typical units with good natural ventilation

Credits scored = 0.2 × (% of typical units with good natural ventilation)

For Option 2 – Ventilation Design (without the use of ventilation simulation modelling) and use of Energy Efficient Cooling System

Up to 10 credits can be scored for the following design

Option 2(i) Air flow within Dwelling Units

- **Building layout design** that utilises prevailing wind conditions to achieve adequate cross ventilation.

  0.5 credit for every 10% of units with window opening facing north **AND** south directions

  Credits scored = 0.5 x (% of units/10)

- **Dwelling unit design** that allows for true cross ventilation in the living room and bedrooms of the dwelling units

  0.5 credit for every 10% of living rooms and bedrooms design with true cross ventilation

  Credits scored = 0.5 x (% of rooms/10)

  Note: In Malaysia, the prevailing wind comes from two predominant directions; that is the north-east during the Northeast monsoon season and south to south-east during South-west monsoon season. 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.

Building Layout Design

Window openings are not required to be oriented perpendicular to the prevailing wind direction. Window openings oriented within the directional ranges of north-west to north-east and south-west to south-east shall be deemed to satisfy the prevailing wind orientation requirement.

Only window openings serving habitable spaces shall be considered. Window openings serving toilets, bathrooms, and store rooms shall be excluded from consideration

For high-rise residential building, windows along double loaded corridor will not fulfil this criteria's unless they are facing an air well or void whereby unobstructed airflow can be reasonable expected.

An oblique angle is considered acceptable as illustrated (Refer Illustration 1-2.1 to 1-2.4).

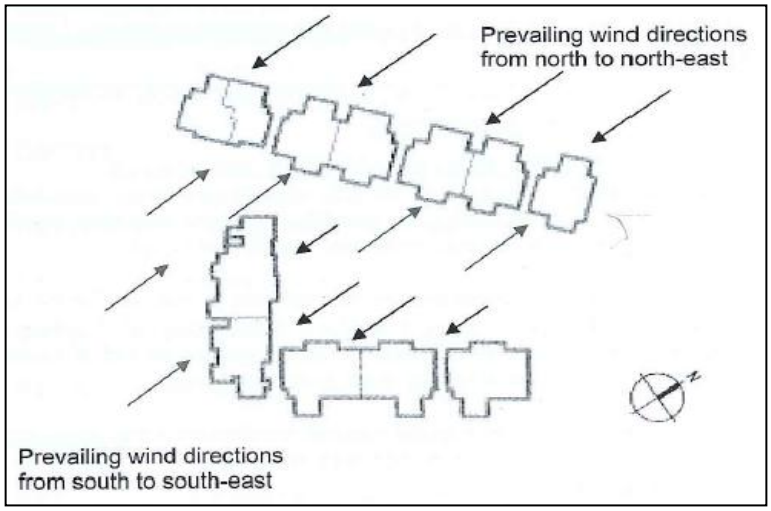


Illustration 1-2.1: Building layout design that facilitate cross ventilation

Building layout showing all dwelling units with window openings facing the north and south direction. In this instance, all units can be considered meeting the requirement 1-2(a) Option 2(i).

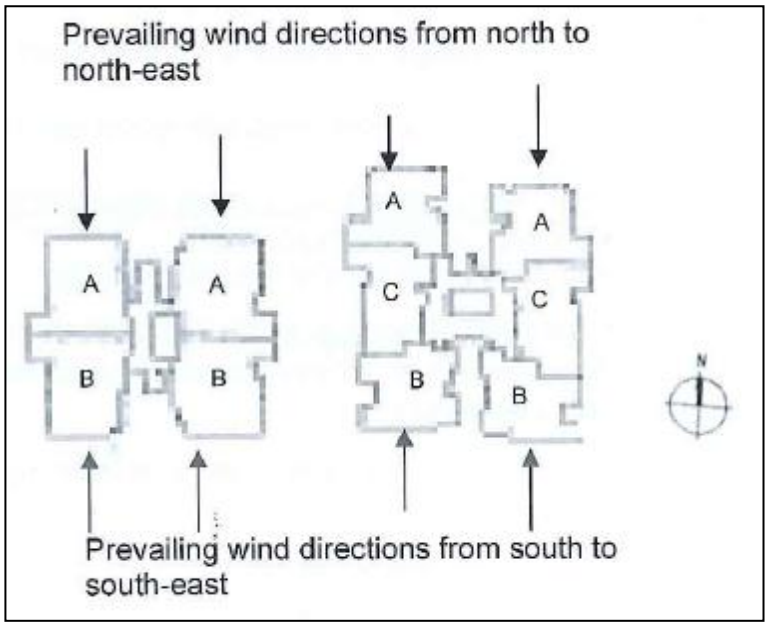


Illustration 1-2.2: Building layout design that facilitate cross ventilation

Building layout showing all dwelling unit Type A and B with window openings facing the north or south direction. The dwelling unit Types C has no window openings in the north and south directions. In this instance, no unit can be considered meeting the requirement 1-2(a) Option 2(i)

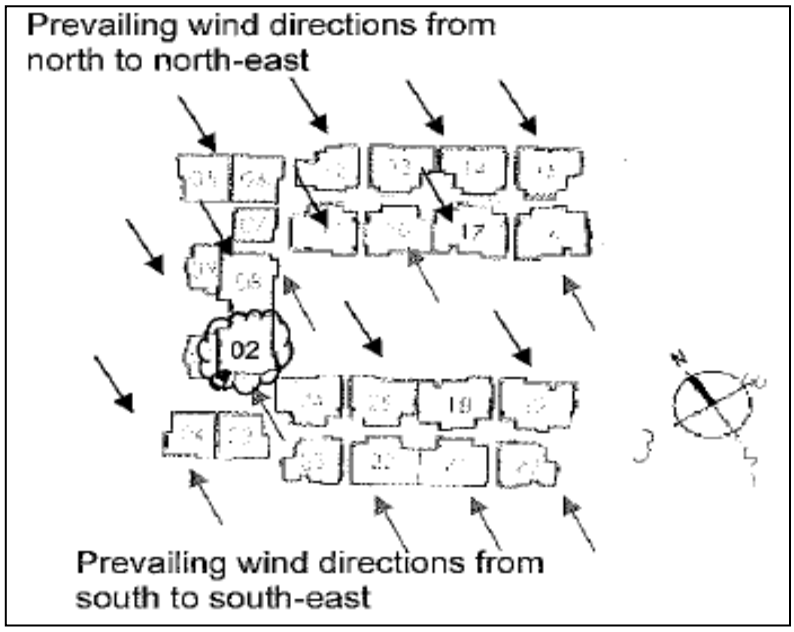


Illustration 1-2.3: Building layout design that facilitate cross ventilation

Building layout showing the window openings of all dwelling units facing the north and south direction except dwelling unit 02. Dwelling unit 02 has window opening facing only the south direction and hence it is not considered meeting the requirements 1-2(a) Option 2(i)

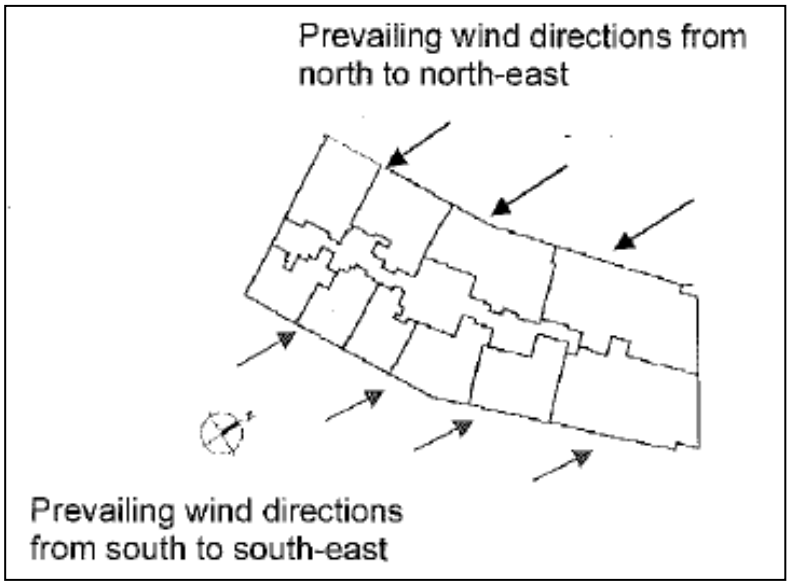


Illustration 1-2.4: Building layout design that facilitate cross ventilation

Building layout showing the window openings of all dwelling units facing either the north or south direction and hence they are not considered meeting the requirement 1-2(a) Option 2(i)

Dwelling Unit Design

Dwelling unit design is considered to have true cross-ventilation when there is a reasonably unobstructed air flow path between the windows or vents on opposite sides of the building. For this requirement, the following requirement to be considered:

- The main entrance of dwelling units is assumed to be closed and all the windows/internal doors are assumed to be open.
- The cross-ventilation path is allowed to traverse multiple functional spaces whereby doors are reasonably expected to be kept open. This includes bedrooms, living-room, dining, and kitchen areas.
- Cross ventilation path traversing functional spaces whereby doors will normally be closed (e.g. toilets, store rooms etc) shall not be considered.
- The cross-ventilation path between the inlet and outlet should consist of not more than two straight lines (one turn only), from the middle of one opening to the other.
- The angle of the cross-ventilation path should not be greater than 90°.
- The maximum distance between the inlet and outlet for adequate cross ventilation is ≤ 12m. For single sided ventilation, the room depth is ≤ 6m. This can be extended to 12m with the use of air movement technologies such as ceiling fan.
- For single sided ventilation, the total openable window area in aggregate should not be ≤ 7.5% of the area of space required to be ventilated.
- For cross ventilation, the total openable window area in aggregate should not be ≤ 10% of the area of space required to be ventilated.

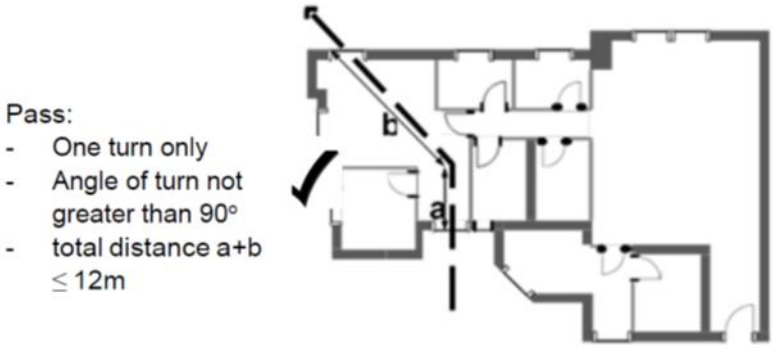


Figure 3

- The minimum opening size (i.e. either inlet or outlet) shall be ≥ 5% of the area of space required to be ventilated) Dwelling unit layout showing that both living room and bedroom 1 are considered to have true cross ventilation and meet the requirement 1-2(a) Option 2(i)

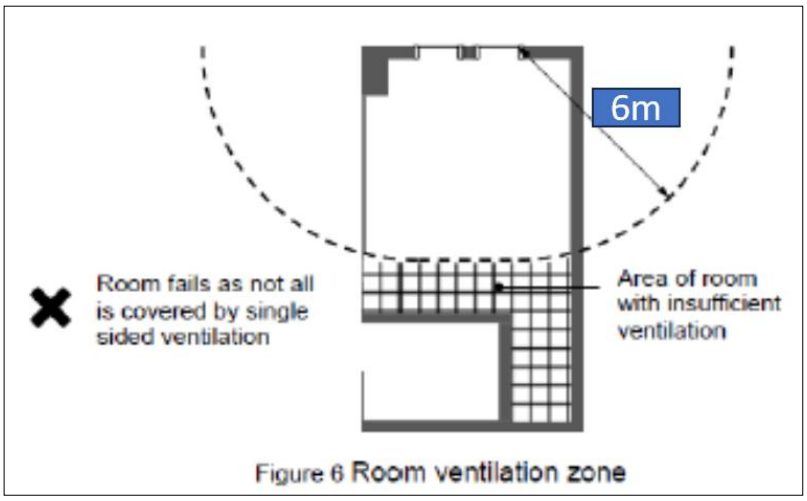


Illustration 1-2.5: Dwelling unit design that facilitates true cross ventilation

- Bedroom which is not considered to have true cross ventilation with single sided since the depth of the room is more than 6m. This can be extended to 12m with the use of air movement technologies such as ceiling fan.

Option 2(ii) Provision of energy efficient cooling system

Up to 10 credits can be scored for the use of the air-conditioners or mechanical ceiling fans that are certified under the Energy Commission (Suruhanjaya Tenaga) or equivalent based on the following rating:

Star rating	Tested CSPF (Wh/Wh)
5	≥5.30
4	4.6 ≤ CSPF ≤ 5.30
3	3.03 ≤ CSPF ≤ 3.30

Table 1-2.1: Unitary air-conditioners, electrically driven, rated cooling capacity < 4.5kW: Cooling Seasonal Peak Factor (CSPF) (Wh/Wh)

Star rating	Tested CSPF (Wh/Wh)
5	≥5.10
4	4.0 ≤ CSPF ≤ 5.10
3	3.1 ≤ CSPF ≤ 4.0

Table 1-2.2: Unitary air-conditioners, electrically driven, rated cooling capacity ≥ 4.5kW ≤ 7.1kW: Cooling Seasonal Peak Factor(CSPF) (Wh/Wh)

Star rating	Efficiency (kW/RT)
5	0.85
4	1.0

Table 1-2-3: Multi-split air-conditioner (including VRF) to refer below for the efficiency compliance

4-Star	4 credits
5-Star	8 credits

Note (1):

- *Points scoring and fulfilment of pre-requisite for air-conditioners will be not be allowed if not provided by the developer for dwelling spaces*
- *Fulfilment of pre-requisite for air-conditioners without point scoring will be allowed if included in building user guide for all dwelling spaces and common areas*

Star rating	COP
5	≥3.00
4	2.74 – 2.99

Table 1-2.4: Mechanical ceiling fan, electrically driven: Minimum COP

Note:
1. The COP for domestic ceiling fan is as follows:

$$\text{COP} = \frac{\textbf{Air Delivery } \left(\frac{\textbf{m3}}{\textbf{min}}\right)}{\textbf{Input Power } (\textbf{W})}$$

4-Star	8 credits
5-Star	10 credits

Extent of coverage: All 100% of air-conditioners and/or mechanical ceiling fans used in all dwelling units are energy labelled minimum Suruhanjaya 3-star (or equivalent) and above.

Note (2):
- *Points scoring and fulfilment of pre-requisite for mechanical ceiling fans will be not be allowed if not provided by the developer for dwelling spaces*
- *Fulfilment of pre-requisite for mechanical ceiling fans without point scoring will be allowed if included in building user guide for all dwelling spaces and common areas*

Note (3): For Option 2(ii) credits scoring only allowed if all dwelling units are provided with energy efficient cooling system. Credits will be pro-rated accordingly based on area of coverage.

1-2 (b) Natural Ventilation in Common Areas

For High-rise Residential

1-2 (b) (i)

1 credit can be scored if at least 80% of the lift lobbies (including private lift lobbies) and corridors areas are designed to be naturally ventilated.

1-2 (b) (ii)

1 credit can be scored if at least 80% of the staircase's areas are designed to be naturally ventilated.

For Landed Home

1-2 (b) (i)

1 credit can be scored if at least 80% of management office and guardhouse areas are designed to be naturally ventilated.

1-2 (b) (ii)

1 credit can be scored if at least 80% of the clubhouse are designed to be naturally ventilated.

PREREQUISITE REQUIREMENTS

a. To be eligible for GreenRE Platinum, it is a requirement to use ventilation simulation modelling and analysis to identify the most effective building design and layout. The simulation results and the recommendations derived are to be implemented. A minimum 50% of the selected typical dwelling units must have a weighted average wind velocity of 0.40 m/s. Other than the dwelling units, common areas like staircases and lobbies (excluding those that are in the basement areas) must also be designed as naturally ventilated spaces with provision of openable windows or other opening with aggregate area of not less than 5% of the space required to be ventilated.

b. Prescribed system efficiency of air-conditioning system for all dwelling units to be as follows:

GreenRE Gold & GreenRE Platinum	Air conditioners with ST 5-Star rating or equivalent

GreenRE Gold & GreenRE Platinum	Mechanical ceiling fan with ST 4-Star rating or equivalent

DOCUMENTARY EVIDENCES

For 1-2(a) Option 1 - Ventilation Simulation Modelling

- Printouts of inputs/variables used for the ventilation simulation software.
- All related architectural plan layout used for the ventilation simulation software.
- Ventilation simulation or wind tunnel testing reports summarising the analysis and modelling results for each typical space as well as the recommendations for design.
- Calculation showing the percentage of units achieving good natural ventilation in the prescribed tabulated format.

For 1-2(a) Option 2(i) – Air Flow within Dwelling Units

- Floor plan of all the unit types with highlights if those with window openings facing the north and south directions and/or with true cross ventilation.
- Schedules showing the total number of units in the development and those with window openings facing the north and south direction.
- Schedules showing the total number of living rooms and bedrooms in the development and those with true cross ventilation.

- Calculation showing the percentage of living rooms and bedrooms of dwelling units with true cross ventilation in the prescribed tabulated format.

For 1-2(a) Option 2(ii) – Provision of Energy Efficient Cooling System

- Extracts of the tender specification showing the provision of the types of air- conditioners and/or mechanical ceiling fan for the dwelling units of the development.
- Schedule of air-conditioners and/or mechanical ceiling fan showing the numbers, types and the approved rating from the MS 1525:2019
- All related drawings showing the air-conditioning system and/or mechanical ceiling fan used.
- Technical product information of the air-conditioners and/or mechanical ceiling fan showing the CSPF or Efficiency.

For 1-2(b) – Natural Ventilation in Common Areas

- Plan layouts showing the applicable common areas and confirmation that they are designed to be naturally ventilated.
- Calculation showing the percentage of total applicable common areas with good natural ventilation design.

REFERENCES

1. MS 1525:2019 – Energy Efficiency and Use of Renewable Energy for Non-Residential Building – Code of Practice.
2. MS 2680:2017 – Energy Efficiency and Use of Renewable Energy for Residential Building – Code of Practice
3. For air-conditioner / mechanical ceiling fan rating, can visit Energy Commission (Suruhanjaya Tenaga) www.st.gov.my

WORK EXAMPLE 1-2(a) OPTION 1

A residential development with one block of 20-storey apartments comprises 200 units and with 7 typical dwelling unit layouts or types.

1. Select the five typical dwelling unit types with the greatest number of units for ventilation simulation.
2. Based on the ventilation simulation results, list down the total number of units for each typical dwelling unit type and its corresponding area-weighted average wind velocity as tabulated below.

Dwelling Units Layouts / Types		No. of Units (A)	Area Weighted Average Wind Velocity (B)
1	Typical Layout A	80	0.20
2	Typical Layout B	30	0.30
3	Typical Layout C	20	0.40
4	Typical Layout D	20	0.20
5	Typical Layout E	20	0.30
Total Number of Selected Units (C): 170			
6	Typical Layout F*	15	Not included
7	Typical Layout G*	15	Not included

**Dwelling Unit Layout not selected for simulation*

Table 1-2.2: Total number of units according to dwelling unit types.

Percentage of units achieving good natural ventilation is given by:

$$= \frac{\sum (A \times B)}{C \times 0.4 m/s} \times 100\%$$

$$= \frac{(80 \times 0.20) + (30 \times 0.30) + (20 \times 0.40) + (20 \times 0.20) + (20 \times 0.30)}{170 \times 0.4 m/s} \times 100\%$$

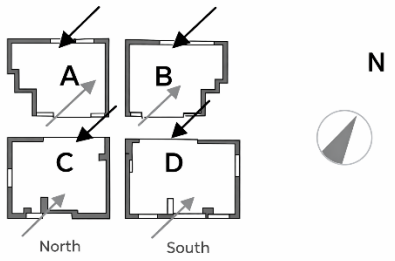
= 63%

63% of the dwelling units meets 0.4 m/s
Hence the credits scored for 1-2(a) Option 1 = 0.2 x 63% = 12.6 credits

WORK EXAMPLE 1-2(a) OPTION 2

For 1-2(a) Option (2)(i)

Proposed residential development with one block of 10 storey apartment comprises 40 units. Each dwelling comes with a living room and two bedrooms. There are four different unit types for this development as illustrated below.



Building Layout Design

Total no. of units in the developments = 40

Total units with all window openings facing north and south directions = 40

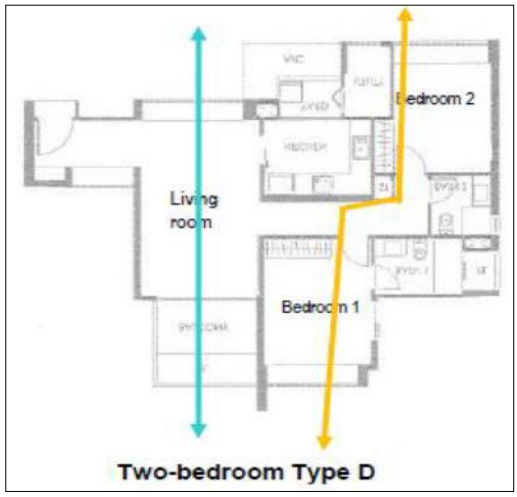
% of units with window openings facing north and south directions = 40/40 x 100%

Credits scored = 0.5 x (% unit/10)
= 0.5 x (100/10)
= **5 credits**

The living room, bedroom 1 and bedroom 2 are considered to have true cross ventilation.

The living room, bedroom 1 and bedroom 2 are considered to have true cross ventilation.

Only living room is considered to have true cross ventilation. Bedroom 1 and 2 do not meet this requirement.



Only living room is considered to have true cross ventilation. Bedroom 1 and 2 do not meet this requirement.

Dwelling Unit Design

Type of dwelling unit	No. of units (a)	For each unit		Total living rooms and bedrooms with true cross ventilation (b + c) x (a)
		Living room with true cross ventilation (b)	Bedrooms with true cross ventilation (c)	
2-bedroom Type A	10	1	1	20
2-bedroom Type B	10	1	1	20
2-bedroom Type C	10	1	0	10
2-bedroom Type D	10	1	0	10
			Total:	60

Table 1-2.3: Percentage of rooms with true cross ventilation

Total no. of living rooms and bedrooms = 3 x 40 units = 120

Total no. of living rooms and bedrooms with true cross ventilation = 60

Percentage of living rooms and bedrooms with true cross ventilation = 60/120 × 100%
= 50%

Credits scored = 0.5 x (% rooms/10)
= 0.5 x (50/10)
= **2.5 credits**

For 1-2(a) Option (2)(ii)

All dwelling units are provided with 5-star rated air-conditioners

Credits scored for 1-2(a) Option 2 (ii) = **8 credits**

Total credits scored for 1-2(a) Option 2 = 5 + 2.5 + 8
= **15.5 credits**

WORK EXAMPLE 1-2(b)

Proposed development has the following provision:

All lift lobbies and corridors are designed to be naturally ventilated except for two private lobbies of the penthouses units that are designed with air-conditioning system. All staircases are designed to be naturally ventilated.

No credit for 1-2(b)(i) if less than 80% of lift lobbies are naturally ventilated.

1 credit for 1-2(b)(ii) for staircases that are all designed to be naturally ventilated.

Therefore, credit scored for 1-2(b) = 1 credit

RES 1-3 DAYLIGHTING

OBJECTIVES

Encourage design that optimises the use of effective day lighting to reduce energy use for artificial lighting.

APPLICABILITY

1-3(a)

Applicable to all normally occupied areas within the development.

1-3(b)

Applicable to all common areas within the development.

BASELINE STANDARD

1-3(a)

The minimum illuminance level for day lighting shall be in accordance with MS 2680:2017.

REQUIREMENTS

1-3(a)

Up to 3 credits can be scored for the use of daylight simulation analysis or any relevant calculation documents to verify that 50% or more of all habitable spaces achieve adequate daylight illuminance levels as specified in Clause 5.4.2 in MS 2680:2017.

The scoring will be based on percentage of habitable spaces with adequate ambient lighting level.

Percentage of Habitable Spaces with Adequate Ambient Lighting Level	Credits Allocated
50% - 75%	1
76% - 90%	2
>90%	3

Table 1-3.1: Credits allocation according to Habitable Spaces

For High-rise Residential

1-3 (b) (i)

1 credit for provision of day lighting for lift lobbies and corridors.

1-3 (b) (ii)

1 credit for provision of day lighting for staircases.

1-3(b) (iii)

1 credit for provision of day lighting for car parks.

For Landed Home

1-3 (b) (i)

1 credit for provision of day lighting for management office.

1-3 (b) (ii)

1 credit for provision of day lighting for guardhouse.

1-3 (b) (iii)

1 credit for provision of day lighting for clubhouse.

Note:

a. *Simulation or suitable daylight calculation is necessary for occupied space and common area to achieve the minimum daylight factors required.*
b. *For common areas, artificial lighting circuit schematics are necessary as documentary to proof design that allows controllability to maximise harvested daylight.*

DOCUMENTARY EVIDENCES

For 1-3(a)

- Printouts of inputs/variables used for the daylight simulation software.
- All related architectural plan layout used for the daylight simulation software showing the fenestration areas for each habitable space.
- Schedules showing the total number of living and dining areas in the development and those with effective daylighting.
- Daylight simulation report summarizing the analysis and modelling results for each living and dining area that meets the requirement or any relevant calculation.

For 1-3(b)

- Extracts of the tender specification or drawings showing the use of day lighting for lift lobbies and corridors, staircases and car parks where applicable.
- Calculation showing the percentage of total applicable common areas with effective daylighting.
- Daylight simulation report summarizing the analysis and modelling results for each applicable common area.

REFERENCES

MS 2680:2017 – Energy Efficiency and Use of Renewable Energy for Residential Building – Code of Practice

WORK EXAMPLE 1-3(a)

Proposed development comprises 20 storey apartments consists of 250 units with 7 typical layouts. Daylight and glare simulation has been conducted for the development. Based on simulation, a tabulation of daylight factor for each of the habitable rooms according to 7 typical layouts as schedule below:

	Room 1	Room 2	Room 3	Room 4	Room 5	Family	Living/Dining
Type A	3.9	4.1	2.1	NA	NA	NA	2.8
Type B	3.9	4.1	2.1	NA	NA	NA	2.8
Type C	3.3	2.5	2.3	1.9	NA	NA	3.8
Type D	3.3	2.5	2.3	1.9	NA	NA	3.8
Type E	3.3	2.5	2.3	1.9	NA	NA	3.8
Type F	4.5	1.1	2.6	2.3	NA	1.7	4.0
Type G	3.3	3.5	3	2.5	2.1	1.6	4.7

Table 1-3.2: Daylight factor for each of the room in every type of layout

Total no. of habitable rooms calculated based on each type of units = 36

Total no. of habitable rooms with DF ≥ 2.0% = 30

Total % of habitable rooms with DF ≥ 2.0% = 30/36 × 100 = 83.3%

Credits scored for 1-3(a) = 2 credits

WORK EXAMPLE 1-3(b)

Proposed residential development with the following provision:

All lift lobbies (including private lift lobbies), corridors and staircases are designed to have adequate day lighting that would eliminate the need for artificial lighting during daytime. 75% of the car park areas have day lighting provision while the other 25% of the car park areas need to employ the use of artificial lighting to maintain proper lighting level.

No.	Criteria	Credit Allocated	Credit
1-3(b)(i)	Lift lobbies and corridors	1	1
1-3(b)(ii)	Staircases	1	1
1-3(b)(iiii)	Day lighting for carpark	1	0.75
		TOTAL	**2.75**

As carpark achieves adequate daylighting in only 75% of applicable areas (<80%) – scoring will be prorated to 0.75.

Therefore, credits scored for 1-3(b) = 2.75 credits

RES 1-4 ARTIFICIAL LIGHTING

OBJECTIVES

Encourage the use of energy efficient lighting to minimise energy consumption from lighting usage

APPLICABILITY

Applicable to lighting provisions that designed in accordance to the luminance level as recommended in MS 1525:2019.

Use of suitable and effective light fitting such as LED, T5 and etc can contribute to better energy efficiency in buildings.

BASELINE STANDARD

Luminance level stated in MS 1525:2019 – Energy Efficiency and Use of Renewable Energy for Non-Residential Building – Code of Practice

REQUIREMENTS

Up to 8 credits can be scored for the improvement in the lighting power budget in common areas.

0.15 credit for every percentage improvement in the lighting power budget over the baseline standard. That is:

Credits scored = 0.15 x (% improvement)

Please refer to Table 15 in MS 1525:2019 for maximum lighting power budget (intensity) according to type of usage. Below are some examples:

Type of usage	Maximum Lighting Power Budget (W/m^2)
Stairs	5
Corridors	5
Lobbies	5
Toilets	6
Gymnasium (Exercise area)	5

Table 1-4.1: Lighting power budget

Remarks:

1. Display lighting, specialised lighting and building's exterior lighting are to be included in the calculation of lighting power budget.
2. The lighting power budget shall not apply in individual residences and apartments but shall apply to common area such as landscape lighting, mechanical rooms, stairs, lobbies, corridors within the residential building (excluding car park).
3. For landed homes street lighting to be excluded from the lighting power budget calculation

DOCUMENTARY EVIDENCES

- Lighting layout plan.
- Lighting schedules showing the numbers, locations and types of luminaries used.
- Calculation of the proposed lighting power budget and the percentage, improvement in the prescribed tabulated format.
- Technical product information of the lighting luminaries used.

REFERENCES

MS 1525:2019 – Energy Efficiency and Use of Renewable Energy for Non-Residential Building – Code of Practice

WORK EXAMPLE 1-4

a. Determine the total power consumption based on the lighting layout design for each areas and light fitting types used

b. Calculate the total power consumption based on the maximum lighting power budget stated in MS 1525:2019.

c. Calculate the percentage improvement in the total power consumption.

Description	Areas (m^2) (A)	Light Fitting Type (B)	Power Consumption per fitting (W) (C)	Ballast Loss (W) (D)	No. of Fitting I	Total power consumption based on fitting type [(C+D) x I]
Corridors	580	T5	1x28	3	70	2170
Staircases	420	T5	1x28	3	35	1085
Car parks	1500	T5	1x28	3	130	4030
Exterior Lighting	200	LED bollard	4x1	1	28	140
		Floodlight CDM-TC	1x35	4	15	585
					Total:	8010

Table 1-4.2 : Total power consumption based on each fitting type

Description	Areas (m^2) (A)	Design Data		MS 1525:2019 Requirements	
		Total Power Consumption (by area) (W) (F)	Design Lighting Power Budget (W/m^2) (F/A)	Reference Lighting Power Budget (W/m^2) (H)	Reference Total Power Consumption (by area) (W) (H x A)
Corridors	580	2170	3.74	5	2900
Staircases	420	1085	2.85	5	2100
Car parks	1500	4030	2.69	5	7500
Exterior Lighting	200	725	3.63	3	600
Total:		8010			13100

Table 1-4.3: Total power consumption based on design and MS 1525 requirements

% improvement in the lighting power budget

= [(∑ (H x A) – ∑(F)/∑ (H x A)) x 100]

= ((13100 – 8010)/13100) x 100

= 38.85%

Credits scored = 0.15 x 38.85% = 5.8

Therefore, credit scored for 1-4 should be **5.8 credits.**

RES 1-5 VENTILATION IN CARPARKS

OBJECTIVES

Encourage the use of energy efficient design and control of ventilation systems in car parks.

APPLICABILITY

Applicable to all car park spaces in the development.

REQUIREMENTS

For High-rise Residential Building Only

1-5(a)

2 credits can be scored for car park spaces that are fully naturally ventilated.

1-5(b)

For carparks that have to be mechanically ventilated, credits can be scored for the use of carbon monoxide (CO) sensors in regulating such demand based on the mode of mechanical ventilation (MV) used; 1 credit for carparks using fume extract system and 0.5 credits for those with MV with or without supply.

Note: When there is a combination of different ventilation modes adopted for carpark design, the credits scored under this requirement will be prorated accordingly.

DOCUMENTARY EVIDENCES

For 1-5(a) and (b)

- Plan layouts showing all car park provision for the development with highlights of the car park spaces that are designed to be naturally ventilated and/or mechanical ventilated.

For 1-5

- Plan layouts showing all car park provision for the development with highlights of the car park spaces that are designed to be naturally ventilated and/or mechanical ventilated.
- Plan layout indicating the location of CO sensors and the mode of ventilation adopted for the design.
- Calculation showing the credits allocation if there is a combination of different ventilation mode adopted for the car park design.
- Technical product information of CO sensors and mechanical ventilation.

WORK EXAMPLE 1-5

Proposed development has two levels of basement car parks. Level 1 basement car park (B1) is designed with more than 20% openings for natural ventilation and fume extract system. Level 2 basement car park (B2) is fully mechanically ventilated. CO sensors are installed to control the ventilation system for both car park levels.

Areas of basement car park – B1 = 700m^2
Areas of basement car park – B2 = 500m^2
Total areas = 1200m^2
Credits scored for 1-5 = (700/1200) x 2 + (500/1200) x 1
= 1.58 credits

RES 1-6 DOMESTIC HOT WATER SYSTEM

OBJECTIVES

Encourage the use of innovative hot water heating system to reduce energy bills.

APPLICABILITY

Applicable to all domestic hot water systems in all dwelling units.

REQUIREMENTS

2 credits can be scored for installation of gas water heaters or energy efficient heat pump water heaters.

3 credits can be scored for the use of solar water heaters.

DOCUMENTARY EVIDENCES

- Schematic drawings showing the hot water heating system.
- Technical information of the hot water heating system showing the calculation of solar fraction or solar energy factor for solar water heater.
- Technical product information of the hot water heating system showing the Coefficient of Performance (COP) for gas water heaters or energy efficient heat pump water heaters.
- Sizing calculation for hot water tank.

WORK EXAMPLE 1-6

Proposed development has the following provision;

Solar water heater system serving all hot water needs of dwelling.

Therefore, credits scored for 1-6 = 3 credits

RES 1-7 LIFTS

OBJECTIVES

Encourage the use of energy efficient lifts.

APPLICABILITY

Applicable to **ALL** lifts in the development.

REQUIREMENTS

1 credit can be scored for the use of lift with energy efficient features such as sleep mode or regenerative features or motorless lift.

DOCUMENTARY EVIDENCES

- Extracts of the tender specification indicating the types of lifts and related features used.
- Schedules showing the total number of lifts and its power consumption.
- Technical information of the lifts.

WORK EXAMPLE 1-7

Proposed development has the following provision;

All lifts are regenerative lift

1 credit for the use regenerative lifts

Therefore, credits scored for 1-6 = 1 credit

RES 1-8 COOL HARDSCAPE AREAS

OBJECTIVES

Encourage the use of higher SRI materials for non-roof hardscape areas.

APPLICABILITY

Applicable to all non-roof hardscape areas in the development.

REQUIREMENTS

1 credit can be scored if ≥ 50% of non-roof hardscape areas are finished with materials or finishes with a Solar Reflective Index (SRI) value of 29 or more.

2 credits can be scored if ≥ 75% of non-roof hardscape areas are finished with materials or finishes with a Solar Reflective Index (SRI) value of 29 or more.

The area of application for % calculation of hardscape material SRI will be for the ground floor site ONLY. This can be estimated by the following formula:

Site area – Plinth Area – Soft scape area = Hardscape area

DOCUMENTARY EVIDENCES

- Layout plans showing the composition of the hardscape area.
- Technical specifications showing SRI value of hardscape area.

WORK EXAMPLE 1-8

Proposed development has the following provision;

≥ 75% of all non-roof hardscape area have material with SRI of 29 or more.

Therefore, credits scored for 1-8 = 2 credits

RES 1-9 ENERGY EFFICIENT FEATURES

OBJECTIVES

Encourage the use of energy efficient features that are innovative and have positive environmental impact in term of energy saving.

APPLICABILITY

Applicable to practices and features that are not listed in the requirements under Part 1 – Energy Efficiency.

REQUIREMENTS

a. 0.5 credit for the use of energy efficient equipment or products that are certified by approved local certification body for at least 90% of the applicable equipment type or products. (Up to 2 credits)

b. Up to 5 credits can be scored for the use of the following energy efficient features based on their potential environmental benefits and the extent of coverage.

i. Use of thermal insulation on the east and west facing external walls

- 2 credits for window to wall ratio (WWR) of less than 0.5
- 1 credit for WWR that is between 0.5 – 0.75
- 0.5 credit for WWR of more than 0.75

ii. Use of occupancy sensors for private lift lobbies, staircases, common toilets

- 1 credit for at least 50 occupancy sensors installed
- 0.5 credit for less than 50 occupancy sensors installed

iii. Provision of vertical greenery system on building façades abutting the living, dining and bedrooms areas of dwelling units and club house.

- 2 credits for more than 50% of building façades
- 1 credit for at least 25% of building façades
- 0.5 credit for clubhouse

iv.Provision of clothes drying facilities and open spaces

- 1 credit for more than 90% of all dwelling units
- 0.5 credit for between 50% to 90% of dwelling units

v. 0.5 credit for the provision of ductless fans for basement ventilation.

vi. 0.5 credit for the computation of EUI for common facilities of the development.

Calculation of EUI for Common Facilities:

EUI: Total electricity consumption for common facilities (kWh/day) / Total Area for the common area

Note:
Common area usage should include all consumption including, corridor, M&E room, landscape, façade lighting, guardhouse and etc. (excluding EV charging consumption)

Total area for common area = Area of common area or facilities in the building (inclusive of the outdoor landscape area and carpark)

The common facilities and the daily usage hours of these facilities are pre-determined for consistency *as* shown in Table 1-9.1. They are to be used in the computation for EUI. Other common facilities that are not listed should be included under 'Others' and the operation hours can be estimated based on the likely usage pattern.

Description	Daily Usage (hr)
A. Mechanical Load	
MV fan (plant room)	9
Car park fan	4
A/C for club house	12
A/C for lobbies	12
A/C for guard house	24
Domestic pump	2
Ejector pump	2
Booster pump	3
Sump pump	0.5
B. Lift Load	
Passenger lifts	2
Service lift	2
C. General Lighting	
Guard house lighting	12
Façade lighting	5
Landscape lighting – 12 hours operation	12
Landscape lighting – 5 hours operation	5
Lift lobbies, corridors & staircase lighting – 12 hours operation	12
Lift lobbies, corridor & staircase lighting – 5 hours operation	5
D. Club Facilities	
Club house interior lighting	12
Power to Gym equipment, SPA, etc	6
Swimming pool filtration	12
Water features	8
E. Others	
Facilities A	To estimate
Facilities B	To estimate

Table 1-9.1: Common Facilities and Daily Usage Pattern

Notes: For features that are not listed in RES 1-9 (i) to (vqw0065Xi) above, the QP is required to submit the details showing the positive environmental impacts and potential energy savings of the proposed features to GreenRE for assessment.

DOCUMENTARY EVIDENCES

- Extracts of the tender specification showing the provision of the proposed energy efficient features and the extent of implementation where applicable.
- Technical product information on the energy efficient features used.
- Calculation of the potential energy saving that could be reaped from the use of these features.
- Calculation of the Energy Efficiency Index (EUI) using the pre-determined daily usage pattern and in the prescribed tabulated format.
- Detail calculation including operation hours for the estimated energy load for each component in the building etc.: lighting, air conditioning system, pump, receptacle load.

WORK EXAMPLE 1-9(vi)

Background info:

Proposed residential development with the following estimated electricity consumption for common facilities.

Description	Estimated Load (kW)	Daily Usage (hr)	Load per day (kWh)
A. Mechanical Load			
MV fan (plant room)	9	9	81
Car park fan	320	4	1280
A/C for club house	8	12	96
A/C for lobbies (1ststy & Basement)	0	12	0
A/C for guard house	2	24	48
Domestic pump	70	2	140
Ejector pump	13	2	26
Booster pump	28	3	84
Sump pump	12	0.5	6
B. Lift Load			
Passenger lifts	470	2	940
Service lift	0	2	0
C. General Lighting			
Car park lighting – 24 hours operation	23	24	552
Car park lighting – 5 hours operation	23	5	115
Guard house lighting	0.3	12	3.6
Façade lighting	0	5	0
Landscape lighting – 12 hours operation	30	12	360
Landscape lighting – 5 hours operation	28	5	140
Lift lobbies, corridors & staircase lighting – 12 hours operation	20	12	240
Lift lobbies, corridor & staircase lighting – 5 hours operation	19	5	95
D. Club Facilities			
Club house interior lighting	12	12	144
Power to Gym equipment, SPA, etc	85	6	510
Swimming pool filtration	50	12	600
Water features	25	8	200
Total kWh per day			**5660.60**

Table 1-9.2: Estimated electricity consumption for common facilities

Calculation of EUI for common facilities;

Total consumption per day = 5,660.60 kWh/day

EUI = (TEC/GFA) x 365 days

= (5,660.60/40,000) x 365

= 51.65 kWh/m^2/year

RES 1-10 RENEWABLE ENERGY

OBJECTIVES

Encourage the use of renewable energy sources in buildings.

APPLICABILITY

Includes all renewable energy sources

REQUIREMENTS

Up to 16 credits can be scored based on the percentage replacement of electricity by the renewable energy source

a. Provision of renewable energy

For High-rise Residential

3 credits for every 1% replacement of electricity (based on annual electricity consumption exclude household's usage) by renewable energy or 3 credits for every 10% of roof area utilized for solar panels.

For Landed Homes

3 credits for every 5% replacement of electricity by renewable energy (per house unit)

Or

b. For building where solar panels are not installed, provide solar panel installation ready roof. Appropriate roof pitch, static loads, mounting system, and roof access to be considered.

Condition: The credits scored for renewable energy provision shall not result in a double grade jump in GreenRE rating (i.e., from GreenRE Bronze to Silver to Gold to Platinum).

DOCUMENTARY EVIDENCES

- Extract of the tender specification and plans showing the location of the renewable energy system and the extent of implementation.

- Technical product information on the salient features of the renewable energy system and the expected renewable energy generated.
- Plan layout of location for installation of renewable energy system, total kWp and predicted annual generation kWh.
- Calculation of the percentage replacement of electricity and the total annual electricity consumption of the development.

WORK EXAMPLE 1-10

A residential development with GFA of 15,000m^2.

The Energy Efficiency Index for its common facilities is 50 kWh/m^2/year

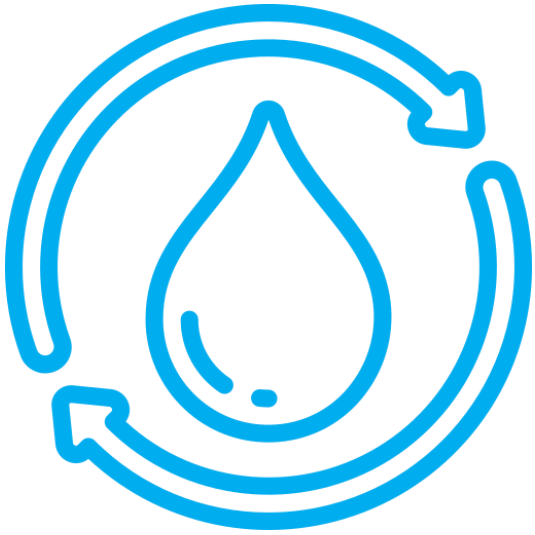
The installation of solar array on the roof of its open car park was estimated to generate 7,500 kWh annually

Total electricity consumption of the development's common areas
= 50 x 15,000 = 750, 000 kWh/year

Percentage of replacement of electricity by renewable energy
= 7,500 / 750,000 x 100%
= 1%

Credits scored for 1-10 for 1% replacement of electricity = 3 credits

Other Green Requirements



Part 2 – Water Efficiency

RES 2-1 Water Efficient Fittings

RES 2-2 Water Usage Monitoring

RES 2-3 Irrigation System and Landscaping

RES 2-1 WATER EFFICIENT FITTINGS

OBJECTIVES

Reduce the use of potable water by using water efficient fittings covered under the Water Efficiency Product Labelling Scheme (WEPLS) or Water Efficiency Labelling Scheme (WELS).

APPLICABILITY

Applicable to the water fittings covered by the WEPLS or WELS as follows:

- Basin taps and mixers
- Flushing cistern
- Sink/bib taps and mixers
- Shower taps and mixers and showerheads
- Urinals and urinals flush valve

BASELINE STANDARD

As specified under Water Efficiency Product Labelling Scheme (WEPLS) or Water Efficiency Labelling Scheme (WELS).

REQUIREMENTS

Up to 8 credits can be scored based on the number and water efficiency rating of the fitting type used (at least 90% of the fitting used).

Rating Based on Water Efficiency Products Labelling Scheme (WEPLS)		
Efficient*	Highly Efficient**	Most Efficient***
0.5 credit	**1 credit**	**2 credits**

Note: At least 90% of each fitting type must be rated to be able to score for the credits

DOCUMENTARY EVIDENCES

- Extracts of the tender specification showing all the water fitting provisions for the development.
- Water fitting schedules showing the numbers, types and the approved rating of the proposed fittings in the prescribed tabulated format shown in the worked example.
- Schematic drawing of cold water and sanitary plumbing.
- Calculation showing the percentage of proposed water fittings that are approved under any international recognized water efficiency labelling scheme e.g. WEPLS or WELS.
- WEPLS or WELS product specification or certificate. In the event of no product recognition from WEPLS or WELS, product catalogue and test report from local or international body that equivalent to the SIRIM standard of testing is required.

REFERENCES

1. For more information on WEPLS, please refer to:

   http://www.span.gov.my/index.php?option=com_content&view

2. For more information of WELS, please refer to:

   http://www.pub.gov.sg/wels/Pages/default.aspx

WORK EXAMPLE 2-1

Example of a water fitting schedule showing the numbers, types and the approve rating of the proposed fitting for a residential development (including common facilities such as clubhouse toilets).

Ref.	Water Fitting Type	WEPLS rating				Total	Percentage of rated fittings (%)	Credits Allocated
		Efficient	Highly Efficient	Most Efficient	Not Rated			
1	Shower taps and mixers	0	45	0	0	45	100	1
2	Basin taps and mixers	0	0	55	0	55	100	2
3	Sink/bib taps and mixers	0	70	0	30	100	70	0
4	Flushing cisterns	0	0	50	0	50	100	2
5	Others – Urinals for club house	0	0	0	5	5	0	0
Total		0	115	105	35	255		5

Table 2-1.1: Computation of credits for water fittings

Credits scored = 5 credits

RES 2-2 WATER USAGE MONITORING

OBJECTIVES

Promote the use of sub meters for better control and monitoring of major water usage.

APPLICABILITY

Applicable to sub-metering provisions for major water uses of the building developments.

The criteria not applicable for the landed homes

REQUIREMENTS

1 credit can be scored if sub meters are provided for **ALL** major water uses i.e. irrigation system, cooling tower and tenant's usage.

DOCUMENTARY EVIDENCES

- Extracts from the tender specification stating the locations and provision of private meters for all major water uses.
- Schematic drawings of cold-water distribution system showing the location of the sub meters provided.

RES 2-3 IRRIGATION SYSTEM AND LANDSCAPING

OBJECTIVES

Reduce potable water consumption by provision of suitable systems that utilities rainwater or recycled water for landscape irrigation and use of plants that require minimal irrigation to reduce potable water consumption.

APPLICABILITY

Applicable to residential development with landscaping provision.

REQUIREMENTS

2-3(a)

1 credit can be scored for the provision of rainwater harvesting system to reduce 30% of landscape irrigation consumption

2-3(b)

1 credit can be scored if more than 50% of the landscape areas are served by water efficient irrigation system with features such as automatic sub-soil drip irrigation system with rain sensor control.

2-3(c)

1 credit can be scored if at least 50% of the landscape areas consist of drought tolerant plants or plants that require minimal irrigation.

DOCUMENTARY EVIDENCES

For 2-3(a)

- Extracts of the tender specification showing how the non-potable water source is to provided.
- Relevant drawings showing the location and design of non-potable water source.
- Calculation showing the percentage of potable water saved for irrigation system.

For 2-3(b)

- Extracts of the tender specification showing the provision and details of water efficient irrigation system;
- Relevant layout plans showing the overall landscape areas and the areas that would be served using the system; and
- Calculation showing the percentage of the landscape areas that would be served using the system.
- Product technical information of the irrigation system.

For 2-3(c)

- Relevant layout plans showing the overall landscape areas and the areas that use drought tolerant plants or plants that require minimal irrigation.
- Calculation showing the percentage of the landscape areas that use drought tolerant plants or plants that require minimal irrigation (at least 80%).
- Plant species showing the minimum water requirement.

REFERENCES

1. Manual Saliran Mesra Alam Malaysia (MSMA) (2000), Ministry of Natural Resources and Environment

2. "Rainwater – Guideline for Installing A Rainwater Collection and Utilization System",KPKT (1999)

3. "Rainwater Harvesting – Guidebook Planning and Design" Department of Irrigation and Drainage, Ministry of Natural Resources and Environment.

4. The list of drought tolerant or resistant plant species may be obtained from the online website: http://florafaunaweb.nparks.gov.sg/

WORK EXAMPLE 2-3(a)

Landscape Consumption

Location	Landscape type	Water Required (L/day)	Quantity		Total watering requirement (L/Day)
GF	Tree	24	200	Nos	4800
	Shrub	6.3	5660	m2	35658
	Turf	3.1	1415	m2	4386.5
					44844.5

Irrigation water requirement (Litre/Day)	44844.5

Roof Catchment

Type	m2	Run-off coefficient
Pitched Tile		0.8
Steel Roof	1239	0.9
RC Roof	1110	0.5
Block Pavement		0.7
Gravel Roadway		0.3

Total Catchment Area (m^2) = 2349
Catchment Area × Run-off coefficient = 1670.1

Type Of System	First Flush System
Equation	Collectible Rainwater = Rainfall x Catchment Area x Run Off Coefficient - (Total Catchment Area x First Flush Diversion)
First Flush Diversion (L/sqm)	1
Tank Size (L)	160,000.00
Total Annual Collected Rain Water (L)	3,880,633.50
Average Daily Collected Rain Water (L)	10,631.87
Irrigation Consumption (L/Day)	44,844.50
Percentage of Reduction (%)	**23.71**

Other Green Requirements

Part 3 – Environmental Protection

RES 3-1 SUSTAINABLE CONSTRUCTION

OBJECTIVES

Encourage recycling and the adoption of building designs, construction practices and materials that are environmentally friendly and sustainable.

APPLICABILITY

Generally applicable to all building developments.

REQUIREMENTS

3-1(a)

Up to 5 credits can be scored with the use of sustainable and recycled materials

Credits can be scored for use of Green Cements with approved industrial by-product such as Ground Granulated Blast Furnace Slag (GGBS), silica fume, and fly ash to replace Ordinary Portland Cement (OPC) based on percentage replacement by mass for superstructural works:

Replacement of OPC by approved industrial by-products (%)	Credit allocation
10	1
20	2
30	3
40	4
≥50	5

Table 3-1.1 : Credits allocation according to replacement percentage

3-1(b)

Up to 5 credits are allocated to encourage more efficient concrete usage for building components based on the percentage reduction in the prescribed Concrete Usage Index (CUI) limit.

Project CUI (m^3/m^2)	Credit allocation
≤ 0.70	1
≤ 0.60	2
≤ 0.50	3
≤ 0.40	4
≤ 0.35	5

Table 3-1.2 : Credits allocation for project CUI

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 metres needed to cast a square metre of constructed floor area. It is expressed as:

$$\text{Concrete Usage Index} = \frac{\text{Concrete Volume } (m^3)}{\text{Constructed Floor Area } (m^2)}$$

DOCUMENTARY EVIDENCES

For 3-1(a)

- Extract of tender specification showing the requirements to use of Green Cement / Concrete.
- Certificate of products showing the recycled content.
- Calculation of estimated quantity of replacement by mass of Green Cement / Concrete.

For 3-1(b)

- Structural plan layout, elevation and sectional plans showing the type of wall system used, the dimensions and sizes of all the building and structural elements.
- Bill of quantities showing the volume of concrete to be used.
- Detail Concrete Usage Index (CUI) calculation showing the quantity of concrete for each floor level.

WORK EXAMPLE 3-1(a)

Proposed development will used Grade 35, 40, 70 and 80 concrete.

From the concrete design mix the percentage of replacement of OPC by the green cements as follow:

Grade 35 = 15.52%
Grade 40 = 63%
Grade 70 = 59 %
Grade 80 = 58 %

No	Concrete Grade	Quantity (m^3)	Percentage of Green Cement (%)	Green Cement Quantity in (m^3)
1	Grade 35	27,381	15.52	4250
2	Grade 40	448	63	282
3	Grade 70	12141	59	7163
4	Grade 80	12155	58	7,050
	Total	**52,155**		**18,745**

Overall % Green Cement replacement = 18,745/52,155 = 35.96%

Hence, achieved **3 credits**

WORK EXAMPLE 3-1(b)

Proposed development comprises a 15-storey residential block with a basement carpark and the following details:

Concrete usage for the superstructure		Constructed floor areas	
For 1st storey	= 587 m^3	For 1st storey	= 1000 m^2
For 2nd to 15th storey (including roof level)	= 5400 m^3	For 2nd to 15th storey (including roof level)	= 14000 m^2
Therefore, Total concrete usage	= 5987 m^3	Therefore, Total constructed floor area	= 15000m^2

Table 3-1.3 : Concrete usage and constructed floor areas

Note: The concrete usage for foundation and two basements are not required to be included.

Concrete Usage Index (CUI) = $\frac{5987}{15000}$ = 0.4 m^3/m^2

Based on the calculation shown in Table 3-1.4

CUI of 0.4 m^3/m^2 ≤ 0.4 m^3/m^2

Therefore, credits scored = 4 credits

Refer to the following Table 3-1.4 for more details

WORK EXAMPLE 3-1(b) – CONT'D

COMPUTATION OF CONCRETE USAGE INDEX		RESIDENTIAL BLDG	
Project Reference No.: AXXXX-00001-2015		Total no. of storey for the project: 15	
Block No: A			
Structural System	**Thickness (mm) or size (mm x mm)**	**Volume of concrete (m^3)**	**Remark ***
1	**1st storey**		
	1.1 Columns	200x400, 200x200	72	Precast
	1.2 Beams	200x400,200x500	145	Precast
	1.3 Slabs	150,200	265	Post-tensioned
	1.4 Staircases	150	30	Precast
	1.5 Suspended structures like planter boxes, bay windows, ledges etc	150	10	Precast
	1.6 Parapets	150	5	RC
	1.7 External walls – load bearing walls	Nil	0	-
	1.8 External walls – non-load bearing walls	125	15	RC
	1.9 Internal walls – load bearing walls	200	40	RC
	1.10 Internal walls – non-load bearing walls	Nil	0	Light weight concrete
	1.11 Others (kerbs, ramps, services risers, etc)	Not required	5	RC
	Total volume of concrete for this storey (m^3)		587	
	Total constructed floor area for this storey (m^2)		1000	
2	**Typical floor layout**			
	2.1 Columns	200x400, 200x200	55	Precast
	2.2 Beams	200x400, 200x500	45	Precast
	2.3 Slabs	150,200	160	Post-tensioned
	2.4 Staircases	150	30	Precast
	2.5 Suspended structures like planter boxes, bay windows, ledges etc	150	10	Precast
	2.6 Parapets	150	5	RC
	2.7 External walls – load bearing walls	Nil	0	-
	2.8 External walls – non-load bearing walls	125	15	RC

COMPUTATION OF CONCRETE USAGE INDEX		RESIDENTIAL BLDG	
Project Reference No.: AXXXX-00001-2015		Total no. of storey for the project: 15	
Block No: A			
Structural System	**Thickness (mm) or size (mm x mm)**	**Volume of concrete (m^3)**	**Remark ***
2	**2nd storey to 30th storey (Typical floor layout)**		
	2.9 Internal walls – load bearing walls	200	40	RC
	2.10 Internal walls – non-load bearing walls	Nil	0	-
	2.11 Others (kerbs, ramps, services risers etc)	Nil	0	-
	Volume of concrete for one storey (m^3)		360	
	Constructed floor area for one storey		933.3	
	Total volume of concrete for 2nd to 15th storey		360x15=5400	
	Total constructed floor area for 2nd to 15th storey (m^2) (including roof level)		933.3x15=14000	
Total volume of concrete for this project (m^3)			5987	
Total constructed floor area for this project (m^2)			15000	
Concrete Usage Index (CUI in m^3/m^2)			0.4	

Table 3-1.4 - Concrete Usage Index

*To indicate if the structural elements is of precast concrete, post-tensioned concrete, high strength concrete (>Grade 60) or reinforced concrete (RC) under the 'Remarks' column

Notes: The quantities of the concrete for all the structural and non-structural elements for each floor level are computed. All the elements listed in the table such as columns, beams, slabs, suspended structures (like planter boxes, bay windows and ledges etc), parapets, walls and others (service risers, kerbs, ramps etc) are to be included. The concrete usages for foundation and basement works are excluded in CUI computation.

RES 3-2 SUSTAINABLE PRODUCTS

OBJECTIVES

Encourage the use of products that are environmentally friendly and sustainable.

APPLICABILITY

Applicable to non-structural and architectural building components.

REQUIREMENTS

a. Up to 8 credits are allocated to encourage the use of appropriate environmentally friendly products that are certified by approved local/international certification body. The products used should have considerably contributions in the overall environmental sustainability standard of the development. Credits scored will be based on the extent of coverage and impact.

1. The environmentally friendly product proposed must be approved by a valid international or local certification body and is subject to GreenRE's evaluation.

Extent of use of environmentally friendly product	Weightage for Credits Allocation
Low impact	0.5
Medium Impact	1
High Impact	2

Table 3-2.1: Weightage for credits allocation

The use of environmental friendly products or recycled materials used for all dwelling units of the development will be considered as high impact (2 credits) on condition that quantities used by percentage are more than 50% (i.e extent of coverage as compared to total quantities used for same intended purpose. If not met, it will be classified as medium impact (1 credit).

Items that are used for all common areas, external works and communal facilities are considered as medium impact (1 credit) if quantities used by percentage are more than 80% (i.e extent of coverage as compared to total quantities used for same intended purpose in common areas If not met, it will be classified as low impact (0.5 credit)

Note:

2. The impact categories listed above generally apply to main building elements – i.e internal / external wall, floor, ceiling, roof, doors, etc. Singular products – i.e termite treatment system, playground equipment, gym flooring etc will be classed as low impact. All applications will be subject to GreenRE's evaluation.
3. Same type of the product not allowed to be double claimed for different area application
4. The credit allocated for low volatile organic compound (VOC) paints and adhesives certified by approved local certification body can be found in RES 4-2 and hence shall not be included in the scoring for RES 3-2.

b. Reuse Salvaged Materials

Up to 1 credit for salvage or reuse construction materials for 2% of building materials based on the total material cost (extracted from the bill of quantities).

c. Recycled Content

Up to 1 credit for the use of recycled content material so that the total of post-consumer recycled content plus half of the pre-consumer content constitutes at least 10% based on the total material cost.

DOCUMENTARY EVIDENCES

- Extracts from the tender specification and drawings showing the requirements to incorporate the environmental friendly products that are certified and approved by local/international certification body.
- Certification details from approved local/international certification body such as the material certification standards, rating and details.
- Technical product information on the sustainable products.
- Calculation of products and extent of coverage.

REFERENCES

For more info on product certification, please refer to:

http://www.sirim-qas.com.my/index.php/zh/our-services/product-certification/eco-labelling-scheme

http://www.sec.org.sg/sgls or http://www.sgbc.sg/green-certifications

WORK EXAMPLE 3-2

Determine if the environmentally friendly products selected are certified with approved local/international certification body. Check if the products used are meant for main building elements or functional spaces and can be considered high impact or low impact. Products that are meant for common areas and external works such as toilets, lobbies and landscaping areas are considered as medium impact or low impact.

Note: Certain products can have more environmentally friendly features than others. Other than recycled materials, they may have features like low VOC assembly or manufactured with resource efficient processes, durability etc that will render the products more environmental friendly than others. If the certified products selected are more environmental friendly and are given a better rating by the approved local/international certification body, a higher weightage can be considered in credit scoring.

Example of a proposed development with the following provisions (all approved by local / international certification body:

a. Use of certified wooden doors for all dwelling units.
b. Use of certified bamboo flooring for all units' bedrooms.
c. Use of certified roof waterproofing coating.

Products and Extent of coverage		With approved certification	Extent use category	Total credits
a.	Wooden doors for all dwelling units	Yes	High	2
b.	Bamboo flooring for all units' bedrooms	Yes	High	2
c.	Roof waterproofing	Yes	Low	0.5

Table 3-2.3: Detail calculation for credits scoring

Therefore, credits scored for 3-2 = 2 + 2 + 0.5 = 4.5 credits

RES 3-3 GREENERY PROVISION

OBJECTIVES

Encourage greater use of greenery and restoration of existing trees to reduce heat island effect.

APPLICABILITY

Applicable to building developments with landscaping areas.

REQUIREMENTS

High-rise Residential

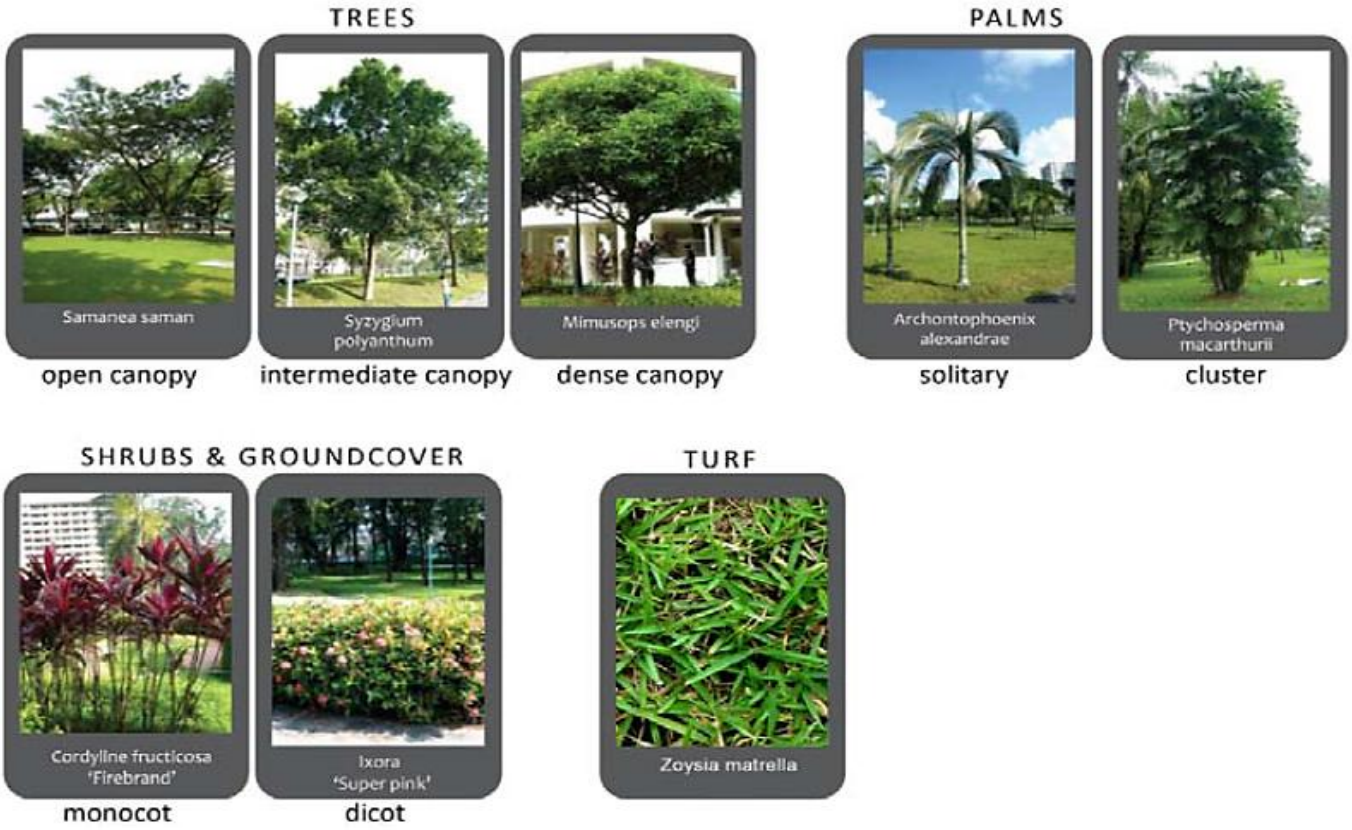
3-3 (a)

Up to 6 credits can be scored for the provision of greenery within the developments including roof top/ sky garden and green roof.

Green Plot Ratio (GnPR) is calculated by considering the 3D volume covered by plants using the following Leaf Area Index (LAI).

Plant Group	Trees	Palms	Shrubs & Groundcover	Turf
LAI	Canopy: Open = 2.5 Intermediate = 3.0 Dense = 4.0	Solitary = 2.5 Cluster = 4.0	Monocot = 3.5 Dicot = 4.5	Turf = 2.0
Area	All = 60 m^2	Solitary = 20m^2 Cluster = 17m^2	Planted area	Planted area

Table 3-3.1: Leaf Area Index (LAI)



Green Plot Ratio (GnPR) = Total Leaf Area / Site Area

GnPR	Credits Allocation
1.0 to < 2.0	1
2.0 to < 3.0	2
3.0 to < 4.0	3
4.0 to < 5.0	4
5.0 to < 6.0	5
≥ 6.0	6

Table 3-3.2 : Credits Allocation according to GnPR

Landed Homes

3-3 (b)

Up to 3 credits can be scored for provision of greenery within non-built up area of each dwelling.

- 50% of non-built up area as greenery area = 1 credit
- 60% of non-built up area as greenery area = 2 credits
- 75% of non-built up area as greenery area = 3 credits

3-3 (c)

Up to 3 credits can be scored for provision of green space over the land area

- 15% more green space = 1 credit
- 20% more green space = 2 credits
- 25% more green space = 3 credits

For all Residential Developments

3-3 (d)

1 credit for restoration of trees on-site, conservation or relocation of existing trees on site. (at least 20%)

3-3 (e)

1 credit for the of compost bins to recycle organic waste to meet at least 30% of landscape fertilizer needs.

DOCUMENTARY EVIDENCES

For 3-3 (a)

- Plan layouts showing the site area as well as the greenery that is provided within the development (including a listing of the number of trees, palms, shrubs, turf and the respective sub category and LAI values.
- Calculation showing the extent of the greenery provision in the prescribed tabulated formats.
- The plant species sub categories and its LAI values obtained from the online website: http://florafaunaweb.nparks.gov.sg/ (see example below) by searching the common / scientific names of the plants.

For 3-3 (b)

- Landscape layouts showing the area non-built up area as greenery area.
- Calculation showing percentage of greenery area compared to non-built up area.

For 3-3 (c)

- Landscape layouts showing the green space.
- Calculation showing percentage of green space above regulatory requirements.

For 3-3 (d)

- Site layouts showing the existing and final locations (where applicable) and number of the trees to be restored or conserved or relocated.

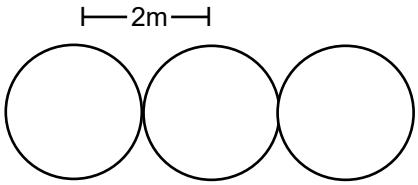
For 3-3 (e)

- Extracts of the tender specification showing the requirements to provide compost bin
- Product specifications.
- Method statement with details steps of composting process (if applicable).
- The calculation of the 30% of fertilizer replacement with the composting

EXCEPTIONS

Trees and Palms Spacing (Centre-to-Centre)

a. If the selected trees and palms are to be planted at ≤ 2m from trunk-to-trunk as illustrated below, the leaf area shall be calculated as the product of LAI value and planted area (in m2).



Columnar Trees

b. For trees that have tight, columnar crowns, the canopy area of 12m2 is to be adopted for calculation of leaf area. These species include, but not limited to the following:
   - Garciniacymosa forma pendula
   - Garciniasubelliptica
   - Polyalthialongifolia
   - Carallia brachiate
   - Gnetumgnemon

REFERENCES

National Parks Board, Singapore - http://florafaunaweb.nparks.gov.sg/

WORKED EXAMPLE 3-3(a)

1. Determine the number of trees, palms and the trees for shrubs and turfs and other greenery area.
2. The Leaf Area Index (LAI) of the individual plant species and its canopy area are predetermined design parameters applicable for all developments.
3. The plant species sub categories and its LAI values can be obtained from the online website: http://florafaunaweb.nparks.gov.sg/ (see example below) by searching the common / scientific names of the plants.
4. Compute the green areas as shown in the Table 3-3.3 below

Category	Sub Category	(A)	(B)	(C)	(A)x(B)x(C)
		LAI value	Canopy area	Qty/Planted Area	Leaf Area
Trees (no.)	Open Canopy	2.5	60 m^2	0 no.	0
	Intermediate Canopy	3.0	60 m^2	8 no.	1440
	Dense Canopy	4.0	60 m^2	12 no.	2880
Palms (no.)	Solitary	2.5	20 m^2	10 no.	500
	Cluster	4.0	17 m^2	10 no.	680
Shrubs (m^2)	Monocot	3.5	NA	0 m^2	0
	Dicot	4.5	NA	20 m^2	90
Turf(m^2)	Turf	2.0	NA	90 m^2	180
Vertical Greenery (m^2)	-	2.0	NA	10 m^2	20
				Total Leaf Area:	**5790**

Table 3-3.3: Calculation of the Green Plot Ratio

Note: Green roof landscaping would be calculated as per illustrated above

Assume site area is 2000 m^2
Green Plot Ratio (GnPR) = total leaf area / site area
= 5790 / 4000 = 2.9 < 3.0

Where GnPR = 2.0 to < 3.0

Therefore, credits scored for 3-3(a) = 2 credits

RES 3-4 ENVIRONMENTAL MANAGEMENT PRACTICE

OBJECTIVES

Encourage the adoption of environmental friendly practices during construction and building operation.

APPLICABILITY

Generally applicable to building developments.

REQUIREMENTS

3-4 (a)

1 credit can be scored if effectively implement the environmentally friendly programmes including monitoring and setting targets to minimise energy use, water use and construction waste during construction stage and include the following practices:

- To record the electrical consumption during the construction stage and hence, minimize energy usage by on-site utilities.
- Appointment of safety, health and environment officer.
- To prepare an Environmental Management Plan and conduct a complete Erosion Sedimentation Control Plan (ESCP).
- To prepare a Construction Waste Management Plan.
- To include commitment to recycle and/or salvage 50% of the volume of non-hazardous construction debris.
- Provide at least the minimum level of sanitation/safety facilities for construction workers.
- Use a low-flow flushing system and efficient fitting tap in the construction site office/ showroom.
- Provision of the Rainwater Harvesting System and the strategies of rainwater.
- Develop and implement and IAQ Management plan for Construction.

3-4 (b)

1 credit can be scored if main builder has good track records in completing internationally recognized accredited Green Buildings and adoption of sustainable, environmentally friendly and considerate practices during construction

3-4 (c)

1 credit can be scored if the building quality is assessed and passed under the Quality Assessment System in Construction (QLASSIC) or Construction Quality Assessment system (CONQUAS) Building Quality Assessment System (BuildQUAS).

3-4 (d)

1 credit can be scored for IBS content scoring ≥ 50% based on CIDB IBS scoring scheme.

1 credits can be scored for IBS content scoring ≥ 70% based on CIDB IBS scoring scheme.

3-4 (e)

Up to 1 credit if the developer, main builder, M&E consultant and architect are ISO 14000 certified. 0.25 credits are allocated for each firm that is certified.

3-4 (f)

1 credit if the project team comprises Certified GreenRE Accredited Professional (GREAP) / Green Mark Accredited Professional (GMAP).

3-4 (g)

1 credit can be scored for the provision of building users' guide with details of the environmentally friendly facilities and features within the building and their uses in achieving the intended environment performance during building operation.

The minimum requirement of the Green Building User Guide as follows;

- Details of green building certification i.e. rating tier, scorecard, certificate, validity etc.
- Summary of green building features (ideally with photographs and diagrams)
- Recommended practices for enhanced environmental performance of residence (refer to GreenRE green home user guide)
- Recommended practices for enhanced occupant health and wellbeing (refer to GreenRE green home user guide)
- Green fit out guidelines to details recommended minimum environmental standard to assist building users in making sustainable fit out decisions

3-4 (h)

1 credit can be scored for provision of Sustainable Operation Management Guideline (SOMG) and at least one session of briefing to be conducted to the Building Management Team.

The minimum requirement of the Sustainable Operation Management Guideline as follow;

- Recommended performance standards to assist building users in making sustainable fit out decisions.

- Energy management and monitoring plan – common areas
- Water management and monitoring plan – common areas
- Waste management plan including details of recycling facilities – entire development
- Environmental policy and cleaning strategies / schedule – common areas
- Pandemic response plan (e.g. increased cleaning requirements, closure of common facilities, signages etc)

3-4 (i)

1 credit can be scored for the provision of facilities or recycling bins at each block of development for collection and storage of different recyclable waste such as paper, glass, plastic etc.

For high-rise residential building, waste separation bins to be provided in refuse chamber on each floor and /or a convenient centralized location to implement waste separation accessible to all building resident.

DOCUMENTARY EVIDENCES

For 3-4 (a)

- Extracts of the tender specification showing the requirements for builder to provide and implement environmental friendly programmes to minimise energy use, water use and construction waste.
- Details of the environmental friendly programmes implemented.

For 3-4 (b)

- Main builder's track records details in the adoption of sustainable, environmentally friendly and considerate practices during construction.

For 3-4 (c)

- Extracts of the tender specification showing the requirement to adopt Quality Assessment System in Construction (QLASSIC) where applicable with minimum score of 70%.
- QLASSIC certificate

For 3-4 (d)

- A copy of CIDB IBS Score form.

For 3-4 (e)

- A certified true copy of the ISO 14000 certificate of developer, main contractor, M & E consultant and architect where applicable.

For 3-4 (f)

- A certified true copy of the certificate of Certified GreenRE Accredited Professional (GREAP) / Green Mark Accredited Professional (GMAP) where applicable and a confirmation of their involvement performance during building operation.

For 3-4 (g)

- A copy of the building users' guide containing the details of the environmental friendly facilities and features within the building and their uses in achieving the intended environment performance during building operation.

For 3-4 (h)

- A copy of Sustainable Operation Management Guideline (SOMG) and also at least one session of briefing to be conducted to the Building Management Team.

For 3-4 (i)

- Plan layout showing the location of the recycling bins for collection and storage of different recyclable waste.
- Product catalogue.

RES 3-5 GREEN TRANSPORT

OBJECTIVES

Promote environmental friendly transport options and facilities to reduce pollution from individual car use.

APPLICABILITY

Generally applicable to building developments.

REQUIREMENTS

3-5 (a)

1 credit can be scored for design that provides good access (<800m walking distance) to public transport networks such as MRT/LRT stations or bus stops.

3-5 (b)

1 credit can be scored for provision of covered walkway to facilitate connectivity and the use of public transport.

3-5 (c)

1 credit can be scored for provision of infrastructure for electric charging stations to at least 10% of available parking spaces.

For landed home, infrastructure for electric charging to be provided to all residential units.

3-5 (d)

1 credit can be scored for provision of electric vehicle charging stations and priority parking lots within the development. Provision of minimum of isolator with 7kWp charger

Extent of coverage:
Minimum 1 number priority parking bays for every 100 carpark lots.
EV chargers – 1 for every 200 parking bays. (Cap at 3)

3-5 (e)

Up to 1 credit can be scored for the provision of covered/sheltered bicycles parking lots with rack/locking bar.

Credits scored based on the number of bicycle parking bays provided.

1 credit for the provision of ≥ 10% x number of dwelling units

0.5 credits for the provision ≥ 5% x number of dwelling units

Not applicable for landed home

DOCUMENTARY EVIDENCES

For 3-5 (a)

- Site layout plan in the context of the surrounding area showing the location of the development site and walking path to the location of the MRT/LRT stations and bus stops not more than 800m.

For 3-5 (b)

- Site layout plan showing the connection of covered walkway from the development to the MRT/LRT stations or bus stops.
- Extracts of the tender specification showing the requirement to provide covered walkway.

For 3-5 (c)

- Extracts of the tender specification showing the requirement to provide electric charging stations.
- Plan layout showing the location of the electric charging station in the development.
- Calculation showing infrastructure for electric charging stations is at least 10% of available parking spaces.
- Product technical information.

For 3-5 (d)

- Extracts of the tender specification showing the requirement to provide hybrid/electric vehicle refuelling/recharge stations and priority carparking bays.
- Plan layout showing the location of the electric vehicle charging station in the development.

- Product technical information.

For 3-5 (e)

- Extracts of the tender specification showing the requirement to provide covered/sheltered bicycles parking lots for the development and the total quantity of bicycles lots provided.
- Plan layout showing the location of the covered/sheltered bicycle parking lots.

RES 3-6 STORMWATER MANAGEMENT

OBJECTIVES

Encourage the treatment of stormwater runoff through provision of infiltration or design features before discharge to public drains.

APPLICABILITY

Generally applicable to building developments.

REQUIREMENTS

Up to 3 credits can be scored for the provision of infiltration features or design features for new development and redevelopment whereby the post development stormwater peak discharge rate and quantity is lower than the pre-development peak discharge rate and quantity.

Note: The treatment of stormwater runoff shall be through provision of infiltration or design features as recommended in Urban Storm Water Management (MSMA).

DOCUMENTARY EVIDENCES

- Site layout plans indicating the total site area, total paved area within the site as well as the total catchment areas. Other information such as the total paved areas within the catchment areas, treatment areas and the hydraulic retention time of the design features area to be included where applicable.
- Approved Urban Storm Water Management (MSMA) report complying to Storm Water Best Management Manual

REFERENCES

MSMA – Urban Storm Water Management

RES 3-7 COMMUNITY CONNECTIVITY

OBJECTIVES

Encourage development in urban area with existing infrastructure to minimise the use of private mode of transportation.

APPLICABILITY

Generally applicable to building developments.

REQUIREMENTS

1 credit can be scored for project located within walking distance of 1km to at least 10 Basic Services. Basic Services include, but are not limited to:

- Bank
- Beauty
- Convenience/Grocery
- Day care
- Fire Station
- Hardware
- Laundry
- Library
- Police station
- Park
- Pharmacy
- Post Office
- Restaurant
- School
- Supermarket
- Clinic

DOCUMENTARY EVIDENCES

Site layout plan showing the location of the development site and the location of Basic Services mentioned above.

Other Green Requirements

Part 4 – Indoor Environmental Quality

RES 4-1 Noise Level

RES 4-2 Indoor Air Pollutants

RES 4-3 Waste Disposal

RES 4-4 Indoor Air Quality in Wet Areas

RES 4-1 NOISE LEVEL

OBJECTIVES

Recognise buildings that are designed to consider the potential noise levels within the dwelling units are maintained at an appropriate level. All building partitions to shall be in accordance with required STC ratings.

APPLICABILITY

Generally applicable to building developments.

BASELINE STANDARD

ASTEM E413 or equivalent

REQUIREMENTS

1 credit can be scored if the building is designed to achieve ambient internal noise level as specified:

- 55dB (6am – 10pm) L_{Aeq}
- 45dB (10pm – 6 am) L_{Aeq}

This can be achieved by adhering to the following STC values for residential building partitions

Description	Sound Transmission Class (STC)
Separation between functional spaces within dwelling units and in-between adjacent dwelling units.	40 - 50
Spaces between mechanical and equipment spaces and occupied spaces	50 - 60

For developments that are in close proximity to road with heavy traffic, flyover or highway, it is necessary to have a detailed analysis conducted by the acoustic consultant. Credits can only be scored if the recommendations from the acoustic consultant are implemented.

DOCUMENTARY EVIDENCES

- Extracts of the tender specification showing the requirement to design the occupied space with the ambient sound levels.
- Typical layout with walls and floors noise attenuation properties clearly marked. STC values to be clearly marked.

RES 4-2 INDOOR AIR POLLUTANTS

OBJECTIVES

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

APPLICABILITY

Generally applicable to building developments.

REQUIREMENTS

4-2 (a)

1 credit can be scored for the use of low volatile organic compounds (VOC) paints certified by approved local/ international certification body for at least 90% of the internal wall areas.

4-2 (b)

1 credit can be scored for the use of environmentally friendly adhesives certified by approved local/ international certification body for at least 90% of the applicable building works or areas.

DOCUMENTARY EVIDENCES

For 4-2 (a)

- Extracts of the tender specification showing the requirement to use low VOC paints that are certified by approved local/ international certification body or equivalent.
- Technical product information

For 4-2 (b)

- Extracts of the tender specification showing the requirement to use adhesive with low emission formaldehyde and are certified by approved local/ international certification body or equivalent for all composite wood products used.
- Product catalogue.
- Product certificate.

RES 4-3 WASTE DISPOSAL

OBJECTIVES

Minimise airborne contaminants from waste

APPLICABILITY

Generally applicable to building developments.

REQUIREMENTS

For High-rise Residential

1 credit can be scored if the refuse chutes or waste disposal are located at open ventilation areas such as service balconies or common corridors

For Landed Homes

Not applicable for landed home

DOCUMENTARY EVIDENCES

- Plan layouts showing the location of the refuse chutes for all typical dwelling units.
- Technical product information if applicable.

RES 4-4 INDOOR AIR QUALITY IN WET AREAS

OBJECTIVES

Encourage provision of adequate natural ventilation and day lighting in wet areas.

APPLICABILITY

Generally applicable to all wet areas such as kitchens, bathroom and toilets of the development.

REQUIREMENTS

Up to 2 credits can be scored if there is provision for adequate natural ventilation and day lighting in wet areas i.e. kitchens, bathroom and toilets.

- 2 credits for more than 90% of all applicable areas.
- 1 credit for at least 50% to 90% of all applicable areas.

Note: When there are residential units with open layout (No partition between living and kitchen), the living area will be considered as an air-conditioned space. Then, the kitchen is not allowed to be considered as natural ventilation spaces.

DOCUMENTARY EVIDENCES

- Plan layouts showing the location of the window openings of the kitchens, bathrooms, and toilets for all typical dwelling units.
- Calculation showing the total number of dwelling units with good natural ventilation.

Other Green Requirements

Part 5 – Other Green Features

RES 5-1 GREEN FEATURES & INNOVATIONS

OBJECTIVES

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

APPLICABILITY

Generally applicable to all building development.

REQUIREMENTS

Up to 7 credits can be scored for the use of the following green features depending on their potential environmental benefits and the extent of coverage.

Water efficiency

i. Use of self-cleaning façade system
- 2 credits for more than 75% of the applicable façade areas
- 1 credit for more than 50% of the applicable facade areas
- 0.5 credit for at least 25% of the applicable facade areas

ii. Use of integrated basin/cistern pedestal system
- 2 credit s for more than 50% of all dwelling units' flushing cisterns
- 1 credit for more than 25% of all dwelling units' flushing cisterns
- 0.5 credit for at least 10% of all dwelling units' flushing cisterns

iii. Use of grey water recycling system
- 2 credits for all blocks of the development.
- 1 credit for at least one block of the development.

iv. Provision of system to recycle surface runoff from the vertical green wall and sky garden
- 1 credit for at least 25% of the green areas
- 0.5 credit for less than 25% of the green areas

v. Use of water efficient washing machine with WEPLS "Efficient" rating and above
- 1 credit for more than 90% of all dwelling units.
- 0.5 credit for at least 50% of all dwelling units.

Environmental Protection

i. Use of precast toilet
- 2 credits for more than 75% of all toilets
- 1 credit for more than 50% of all toilets
- 0.5 credit for at least 25% of all toilets

ii. Provision of green roof and roof top garden
- 1 credit for more than 50% of the roof areas
- 0.5 credit or at least 25% of the roof areas

iii. Provision of vertical greening
- 1 credit for more than 50% of the external wall areas
- 0.5 credit for at least 25% of the external wall areas

iv. 1 credit for the provision of double refuse chutes for separating recyclable from non-recyclable waste.

v. 0.5 credit for the use of non-chemical termite treatment system.

vi. Conservation of existing building structure or building envelope (by areas).
- 2 credits for conserving more than 50% of the existing structure or building envelope
- 1 credit for conserving at least 25% of the existing structure or building envelope

vii. 1 credit for the computation of Concrete Usage Index (CUI) of the building development. Only applicable if not attempting in RES 3-1(b)

viii. Adoption of demolition protocol to maximise resource recovery of demolition materials for reuse or recycling.
- 2 credits for recovery rate of more than 35% crushed concrete waste to be sent to the approved recycles with proper facilities
- 1 credit for recovery rate at least 20% crushed concrete waste to be sent to the approved recyclers with proper facilities

Indoor Air Quality

1 credit for the use of pneumatic waste collection system.

Others

0.5 credit for the use of siphonic rainwater discharge system at roof.

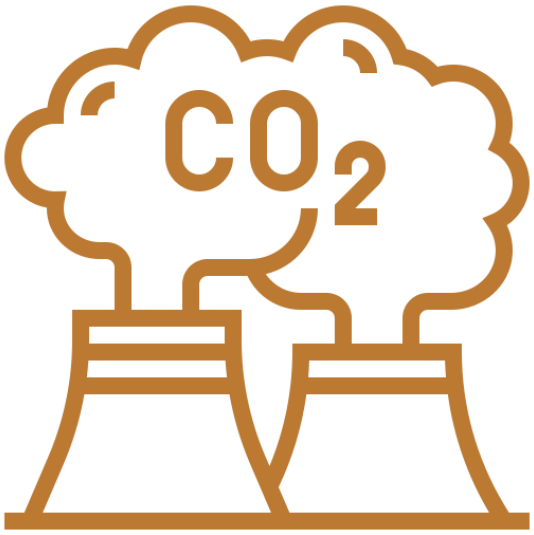
Notes: For features that are not listed above, the QP is required to submit the details showing the positive environmental impacts, possible saving and benefits of the proposed features to GreenRE for assessment.

DOCUMENTARY EVIDENCES

- Extracts of the tender specification showing the provision of the specific green features used and the extent of implementation where applicable.
- Technical product information (including drawing and supporting documents) of the green features.
- Quantified evidences on the potential environmental benefits that the features can bring to the development.

Other Green Requirements

Part 6 – Carbon Emission of Development



RES 6-1 CARBON EMISSION OF DEVELOPMENT

OBJECTIVES

To calculate the carbon emission resulted from the associated energy used during construction and operational phase of a development.

APPLICABILITY

Generally applicable to all building development.

REQUIREMENTS

a. Recognise the carbon emission based on operational carbon emission computation of the building (common + dwelling) comprising energy [B6] and water consumption [B7].

b. Calculation of product stage embodied carbon based on following building materials [A1-A3]:

- concrete
- steel
- bricks
- cement
- metal / aluminium

c. Calculation of construction stage embodied carbon [A4-A5].

d. Reduction from reference embodied carbon (for Ready Mix Concrete, Cement, Steel Reinforcement, Bricks, Steel & Metal)

EC (tCO_2eq/t)				
Ready Mixed Concrete	Cement	Steel Reinforcement	Bricks	Steel & Metal
0.199 - 0.219	0.965 - 1.0857	1.39 - 2.41	0.249 - 0.279	1.478 - 2.498

DOCUMENTARY EVIDENCES

For 6-1 (a)

- Detail calculation for the estimated energy load for each component in the building e.g.: lighting, air-conditioning system, pump, receptacle load.
- Details calculation for estimated water consumption of the building e.g.: water fittings, landscape, water features.
- Technical product information on the energy efficient features and water efficient features used.
- Summary tabulation of estimated total energy savings and total water savings of the development for the year.
- Carbon emission calculation.

For 6-1 (b)

- Embodied carbon calculation

For 6-1 (c)

- Calculation of construction stage embodied carbon [A4-A5]

For 6-1 (d)

- Calculation showing the reduction from reference embodied carbon (for Ready Mix Concrete, Cement, Steel Reinforcement, Bricks, Steel & Metal)

WORK EXAMPLE 6-1

6-1 (a) Operational Carbon Calculation

Table 6-1: Energy Consumption

Type of usage	Design (kWh/yr)	Baseline (kWh/yr)
Lighting	819,498	1,151,575
Air-Conditioning	860,589	1,406,899
M/V System	25,550	25,550
Total Energy Usage	1,705,637	2,584,024

Table 6-1.2: Water Consumption

(Please refer GreenRE Water Calculator)

Type of fixtures	Design (m^3/yr)	Baseline (m^3/yr)
Flow Fixtures	2,402	6,899
Flush Fixtures	5,366	5,161
Total Water Usage	7,768	12,060

Table 6-1.3: Operational Carbon Emission

Type of usage	Design $kgCO_2e/yr$	Baseline $kgCO_2e/yr$
Energy	1,226,619	1,860,497
Water	155,344	241,192
Total Annual Carbon Emission	1,381,963	2,101,689

Energy CO2 Emission Reduction (ktCO2e/annum, based on electricity energy reduction only @ 1kWh) =

- 0.639 kg CO2- Peninsular
- 0.512 kg CO2- Sarawak
- 0.512 kg CO2- Sabah

Water CO2 Emission Reduction = 0.419 kg CO2e/m3

Percentage savings = (2,101,689 - 1,381,963) / 2,101,689 = 34.25%

Credits scored for 6-1 (a) = 1 credit

6-1 (b) Product Stage Embodied Carbon Calculation (A1-A3)

No	Material	Description	Embodied Carbon Factor ($kgCO_2e/kg$)	Quantity		Quantity (kg)	Total Embodied Carbon (tCO_2e)
				Value	Unit		
1	Concrete (G30)	Slab	0.13	5,047	m^3	12,112,800	1,574.66
2	Glass	10mm of Glass (Single Glass excluding Frame)	1.44	12,415	kg	12,415	17.88
3	Steel Reinforcement	Rebar	0.73	247,945	kg	247,945	181.00
4	Brick	Red brick – internal wall	0.21	9,574	m^3	16,850,240	3,538.55
5	Cement	Portland cement	0.91	6,217	m^3	9,748,256	8,870.91
6	Aluminium	Window & door frame	0.93	3,972	kg	3,972	3.69
	Total						**14,186.69**

Table 6-1.4: Tabulation of total embodied carbon of material for product stage (A1-A3)
Source: CIDB- Embodied Carbon Inventory Data for Construction Materials

Credits scored for 6-1 (b) = 1 credit

6-1 (c) Construction Stage Embodied Carbon Calculation (A4 Transport + A5 Material Waste)

No	Mode	TEFmode ($gCO_2e/kg/km$)	Description
1	Road transport emissions	0.1065	For HGV (all diesel)
2	Sea transport emissions	0.01614	For cargo ship, container ship
3	Freight flight emission	0.59943	International
4	Rail flight emissions	0.02556	Freight train

Table 6-1.5: Transport emissions factors for different modes of transport
Source: CIDB- Embodied Carbon Inventory Data for Construction Materials

No	Transport Detail	Emissions Coefficient Factors (ECF) ($kgCO_2e/kg$)
1	Transport for locally manufactured with average distance travelled by road 50km	0.005
2	Transport for national with average distance travelled by road 300km	0.0032

Table 6-1.6: Transport emissions factors for different modes of transport
Source: CIDB- Embodied Carbon Inventory Data for Construction Materials

A4: Quantity × TEFmode x ECF

where:

- Quantity of material in kg
- TEFmode based on mode of transport as in Table 6-1.5
- ECF based on distance for material transported to site (locally sourced or imported material) as in Table 6-1.6

No	Type of Waste	Waste Rate	Waste Factor (tCOe/t)
1	Concrete in situ	5%	0.053
2	Precast concrete	1%	0.01
3	Steel reinforcement	5%	0.053
4	Brick	20%	0.25
5	Cement	5%	0.053
6	Glass	5%	0.053
7	Aluminium	1%	0.01

Table 6-1.7: Waste rate (WR) and waste factor (WF)
Source: istructure.org

A5: WF × (A13 + A4 + C2 + C34)

where:

- WF is the waste factor, based on expected % waste rate (Table 6-1.7)
- A13 is A1–A3 emissions for production of the wasted material, (6-1 (b))
- A4 for transporting the wasted material to site (Table 6-1.6)
- C2 for transporting the wasted material away from site (in the absence of better data, assume 50km by road to the nearest reuse/recycling location = 0.005kgCO_2e/kg)
- C34 is C3–C4 emissions for processing and disposal of the waste material (in the absence of better data, assume 1.77kgCO_2e/kg for timber products and 0.013kgCO_2e/kg for all other materials.

Concrete (A4 + A5)

A4: Quantity (kg) x TEFmode x ECF

= 12,112,800 x 0.1065 x 0.005

= 6,450 kgCO_2e

A5: WF × (A13 + A4 + C2 + C34)

Step 1: A13 = 1,574,664 kgCO2e

A4 = 6,450 kgCO_2e

C2 = 12,112,800 x 0.005 = 60, 564 kgCO2e

C34 = 12,112,800 x 0.013 = 157,467 kgCO2e

Step 2: Sum all components
(A13 + A4 + C2 + C34)

1,574,664 + 6,450 + 60, 564 + 157,467
= 1,799,145 kgCO_2e

Step 3: Apply waste factor
A5 = 0.053 x 1,799,145 = 95,354.68 kg CO_2e

Concrete (A4 + A5) = 6,450 + 95,354.68
= 101,804.68 kgCO_2e

Glass (A4 + A5)
A4: Quantity (kg) x TEFmode x ECF
= 12,415 x 0.1065 x 0.005
= 6.61 kgCO_2e

A5: WF × (A13 + A4 + C2 + C34)
Step 1: A13 = 17,877.60 kgCO2e
A4 = 6.61 kgCO_2e
C2 = 12,415 x 0.005 = 62.08 kgCO2e
C34 = 12,415 x 0.013 = 161.39 kgCO2e

Step 2: Sum all components
(A13 + A4 + C2 + C34)

17,877.60 + 6.61 + 62.08 + 161.39
= 18,107.68 kgCO_2e

Step 3: Apply waste factor
A5 = 0.053 x 18,107.68 = 959.71 kg CO_2e

Glass (A4 + A5) = 6.61 + 959.71
= 996.32 kgCO_2e

Steel Reinforcement (A4 + A5)
A4: Quantity (kg) x TEFmode x ECF
= 247,945 x 0.1065 x 0.005
= 132.03 kgCO_2e

A5: WF × (A13 + A4 + C2 + C34)
Step 1: A13 = 180,999.85 kgCO2e
A4 = 132.03 $kgCO_2e$
C2 = 247,945 x 0.005 = 1,239.73 $kgCO_2e$
C34 = 247,945 x 0.013 = 3,223.28 $kgCO_2e$

Step 2: Sum all components
(A13 + A4 + C2 + C34)

180,999.85 + 132.03 + 1,239.73 + 3,223.28
= 185,594.89 $kgCO_2e$

Step 3: Apply waste factor
A5 = 0.053 x 185,594.89
= 9,836.53 $kgCO_2e$

Steel Reinforcement (A4 + A5) = 132.03 + 9,836.53
= 9,968.56 $kgCO_2e$

Brick (A4 + A5)
A4: Quantity (kg) x TEFmode x ECF
=16,850,240 x 0.1065 x 0.005
= 8,972.75 $kgCO_2e$

A5: WF × (A13 + A4 + C2 + C34)
Step 1: A13 = 3,538,550.40$kgCO_2e$
A4 = 8,972.75 $kgCO_2e$
C2 = 16,850,240 x 0.005 = 84,251.2 $kgCO_2e$
C34 = 16,850,240 x 0.013 = 219,053.31 $kgCO_2e$

Step 2: Sum all components
(A13 + A4 + C2 + C34)

3,538,550.40 + 8,972.75 + 84,251.2 + 219,053.31
= 3,850,827.66 $kgCO_2e$

Step 3: Apply waste factor
A5 = 0.25 x 3,850,827.66
= 962,706,915 $kgCO_2e$

Brick (A4 + A5) = 8,972.75 + 962,706,915
= 971,679.67 $kgCO_2e$

Cement (A4 + A5)
A4: Quantity (kg) x TEFmode x ECF
= 9,748,256 x 0.1065 x 0.005
= 5,190.95 $kgCO_2e$

A5: WF × (A13 + A4 + C2 + C34)
Step 1: A13 = 8,870,912.96 $kgCO_2e$
A4 = 9,748,256 $kgCO_2e$
C2 = 9,748,256 x 0.005 = 48,741.28 $kgCO_2e$
C34 = 9,748,256 x 0.013 = 126,727.33 $kgCO_2e$

Step 2: Sum all components
(A13 + A4 + C2 + C34)

8,870,912.96 + 9,748,256 + 48,741.28 + 126,727.33
= 18,794,637.57 $kgCO_2e$

Step 3: Apply waste factor
A5 = 0.053 x 18,794,637.57
= 996,115.79 $kgCO_2e$

Cement (A4 + A5) = 5,190.95 + 996,115.79
= 1,001,306.74 $kgCO_2e$

Aluminium (A4 + A5)
A4: Quantity (kg) x TEFmode x ECF
= 3,972 x 0.1065 x 0.005
= 2.16 $kgCO_2e$

A5: WF × (A13 + A4 + C2 + C34)
Step 1: A13 = 3,693.96$kgCO_2e$
A4 = 2.16 $kgCO_2e$
C2 = 2.16 x 0.005 = 0.108 $kgCO_2e$
C34 = 2.16 x 0.013 = 0.028 $kgCO_2e$

Step 2: Sum all components
(A13 + A4 + C2 + C34)

3,693.96+ 2.16 + 0.108 + 0.028
= 3,696.26 $kgCO_2e$

Step 3: Apply waste factor

A5 = 0.01 x 3,696.26
= 36.96 kgCO_2e

Aluminium (A4 + A5) = 2.16 + 36.96
= 39.12 kgCO_2e

No	Material	Embodied Carbon Factor (kgCO_2e/ kg)	Quantity (kg)	Material Embodied Carbon *A1-A3* (kgCO_2e)	Transport Embodied Carbon *A4* (kgCO_2e)	Waste Embodied Carbon *A5* (kgCO_2e)	Total Embodied Carbon (kgCO_2e)	Total Embodied Carbon (tCO_2e)
1	Concrete (G30)	0.13	12,112,800	1,574,664	6,450	95,354.68	1,676,468.68	1,676.47
2	Glass	1.44	12,415	17,877.60	6.61	959.71	18,843.92	18.84
3	Steel Reinforcement	0.73	247,945	180,999.85	132.03	9,836.53	190,968.41	190.97
4	Brick	0.21	16,850,240	3,538,550.40	8,972.75	962,706,915	966,254,438.15	966,254.44
5	Cement	0.91	9,748,256	8,870,912.96	5,190.95	996,115.79	10,386,123.75	10,386.12
6	Aluminium	0.93	3,972	3,693.96	2.16	36.96	3,733.08	3.73
	Total							**978,530.57**

Table 6-1.8: Calculation tabulation of materials (A1-A3 + A4 + A5)

Credits scored for 6-1 (c) = 1 credit

For 6-1 (d) Reduction from reference embodied carbon [A1-A5]

Embodied Carbon of Material (Baseline)

EC (tCO_2eq/t)				
Ready Mixed Concrete	Cement	Steel Reinforcement	Bricks	Others
0.219	1.0857	2.41	0.279	Aluminium 2.498 Glass 1.44 Timber 0.266

Table 6-1.9: Embodied carbon factor for each material (baseline)
Source: CIDB Technical Report No 207-GHG Emission for Construction Industry in Malaysia

Sample Bill of Quantities

No	Description of Work/Material	Quantity		Quantity (kg)	RM
		Value	Unit		
1	Concrete (G30, in structural elements, 30% GGBS)	5,047	m^3	12,112,800	xxx
2	Glass (6mm, green tinted low-e glass)	12,415	kg	12,415	xxx
3	Steel Reinforcement (high yield bars, 16mm, >90% scrap content)	247,945	kg	247,945	xxx
4	Brick (fly-ash, hollow bricks)	9,574	m^3	16,850,240	xxx
5	Cement (Green cement – fly ash content)	6,217	m^3	9,748,256	xxx
6	Aluminium (secondary aluminium with >50% recycled content)	3,972	kg	3,972	xxx

Table 6-1.10: Sample of Bill of Quantity

No	Material	Baseline Embodied Carbon Factor ($kgCO_2e/kg$)	Reduced Embodied Carbon Factor ($kgCO_2e/kg$)	Quantity (kg)	Baseline Total Embodied Carbon A1-A3 ($kgCO_2e$)	Reduced Total Embodied Carbon ($kgCO_2e$)
1	Concrete (G30)	0.219	0.13	12,112,800	2,652,703.20	1,574,664
2	Glass	1.44	1.44	12,415	17,877.60	17,877.6
3	Steel Reinforcement	2.41	0.73	247,945	597,547.45	180,999.85
4	Brick	0.279	0.21	16,850,240	4,701,216.96	3,538,550.40
5	Cement	1.0857	0.91	9,748,256	10,583,681.54	8,870,912.96
6	Aluminium	2.498	0.93	3,972	9,922.056	3,693.96

	Total					**14,186.69**

Table 6-1.10: Calculation of total embodied carbon in compare to baseline specified

Material	Baseline Embodied Carbon				Reduced Embodied Carbon			
	Material *A1-A3* ($kgCO_2e$)	Transport *A4* ($kgCO_2e$)	Waste *A5* ($kgCO_2e$)	Total ($kgCO_2e$)	Material *A1-A3* ($kgCO_2e$)	Transport *A4* ($kgCO_2e$)	Waste *A5* ($kgCO_2e$)	Total ($kgCO_2e$)
Concrete (G30)	2,652,703.20	6,450.00	152,490.73	2,811,644.00	1,574,664.00	6,450.00	95,354.66	1,676,468.72
Glass	17,877.60	6.61	959.71	18,843.92	17,877.60	6.61	959.71	18,843.92
Steel Reinforcement	597,547.45	132.03	31,913.55	629,593.03	180,999.85	132.03	9,836.53	190,968.41
Brick	4,177,174.50	8,972.75	1,122,362.89	5,308,510.14	3,538,550.40	8,972.75	962,706.87	4,510,230.02
Cement	8,870,912.96	5,190.95	479,733.34	9,355,837.25	8,870,912.96	5,190.95	479,733.34	9,355,837.25
Aluminium	9,922.06	2.12	99.96	10,024.13	3,693.96	2.12	37.68	3,733.75
Total				**18,134,452.47**				**15,756,082.07**

**A4 - Assuming both quantity (kg) is the same for both cases*

(Baseline – Reduced)/Baseline x 100%
= (18,134,452.47 - 15,756,082.07) / 18,134,452.47
= 13.2%

<u>GreenRE Requirement</u>

>10% 0.5 credit

>30% 1 credit

Credits scored for 6-1 (d) = 0.5 credit

8. Documentation Requirements

All documents submitted for the REHDA GreenRE Assessment should be duly verified and signed by the Qualified Person (QP) and appropriate practitioners where applicable.

The documentation required for ventilation simulation and energy modelling should also be endorsed by the QP and appropriate practitioners as part of the documentary evidences for certification.

GreenRE Criteria	Required Signatories
Part 1 – Energy Efficiency	
RES 1-1 Thermal Performance of Building Envelope- RETV	PA
RES 1-2 Naturally Ventilated Design and Air-Conditioning System	
• Dwelling Unit Comfort	
» Ventilation Simulation/ Design	PA
» Use of energy efficient air conditioners	PE
• Natural Ventilation in Common Areas	PA
RES 1-3 Daylighting	PA
RES 1-4 Artificial Lighting	PE
RES 1-5 Ventilation in Carparks	PE
RES 1-6 Lifts	PE
RES 1-7 Energy Efficient Features	
• Heat Recovery Devices	PE
• Motion Sensors/ Photo Sensors	PE
• Others	S
RES 1-8 Renewable Energy	S
Part 2 – Water Efficiency	
RES 2-1 Water Efficient Fittings	PA
RES 2-2 Water Usage Monitoring	PE
RES 2-3 Irrigation System and Landscaping	PE
Part 3 – Environmental Protection	
RES 3-1 Sustainable Construction	PE
RES 3-2 Sustainable Products	PA
RES 3-3 Greenery Provision	PE
RES 3-4 Environmental Management Practice	PE
RES 3-5 Green Transport	PA
RES 3-6 Stormwater Management	PE
RES 3-7 Community Connectivity	PA
Part 4 – Indoor Environmental Quality	
RES 4-1 Noise Level	S
RES 4-2 Indoor Air Pollutants	PA
RES 4-3 Waste Disposal	PA
RES 4-4 Indoor Air Quality in Wet Areas	PA
Part 5 – Other Green Features	
RES 5-1 Green Features & Innovations	S
Part 6 – Carbon Emission of Development	
RES 6-1 Carbon Emission of Development	S

Table: Summary Checklist and the Corresponding Signatories for GreenRE Residential & Landed Home Criteria

1. PA refers to Professional Architect
2. PE refers to Professional Engineer, Landscape Architect, Planner and Quantity Surveyor (QS)
3. S refers to Specialist which includes Facilitator, Project Manager, Facilities Manager, Energy or Sustainable consultant and Commissioning Specialist