



# **DESIGN REFERENCE GUIDE**

## **Residential Building & Landed Home**

Version 3.2

September 2021

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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 recognized 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 building, the building regulations shall take precedence.

As part of this guideline, the following definitions apply:

**Landed home** – Residential bungalows, villas, terrace houses etc.

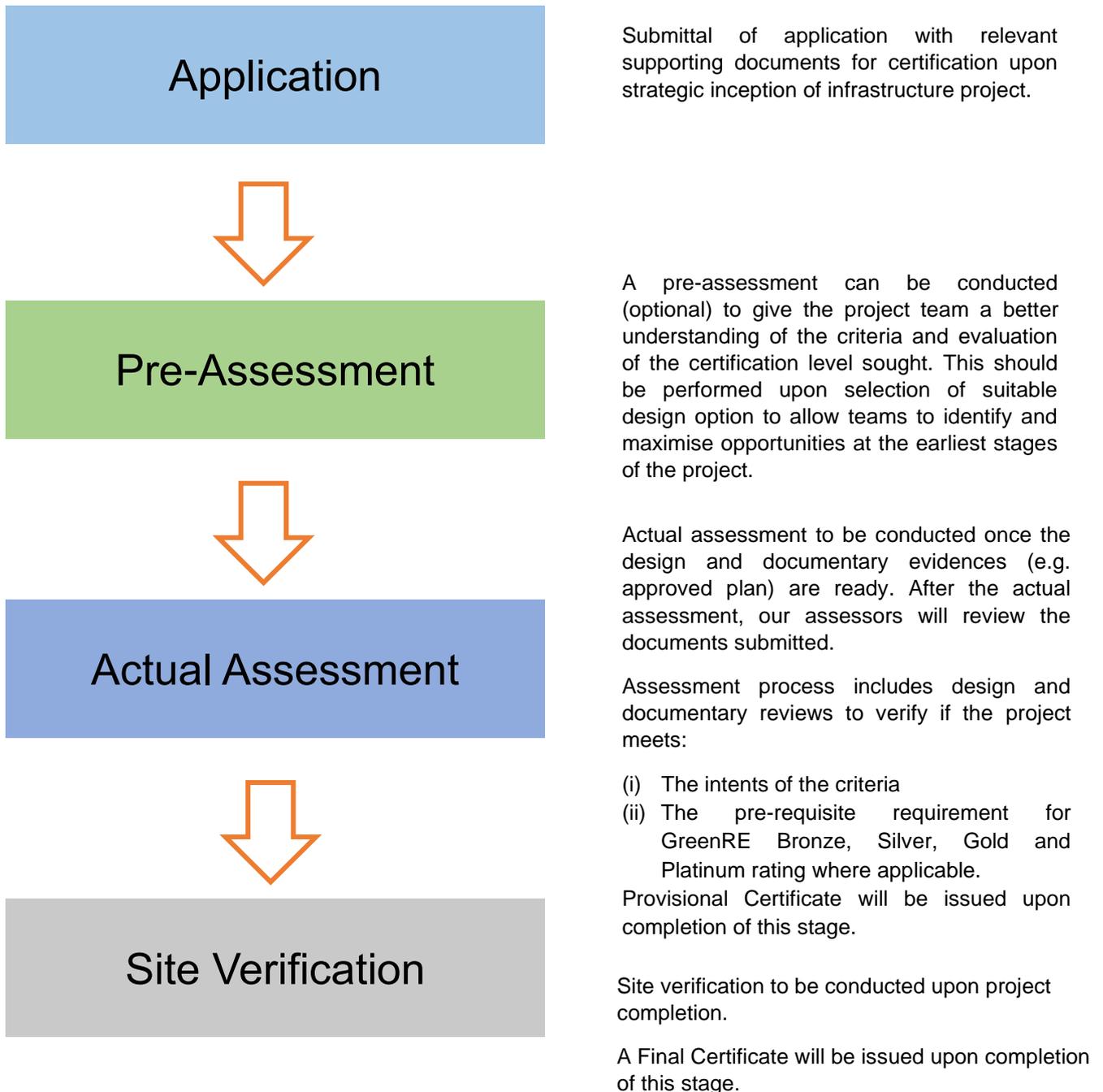
**Multi-storey Residential** – Residential flats or condominiums.

## 3. Revision Log

| Revision | Description                       | Date Effective                 |
|----------|-----------------------------------|--------------------------------|
| 1.1      | Issued for pilot                  | 1 <sup>st</sup> June 2013      |
| 1.2      | Revised version of implementation | 1 <sup>st</sup> June 2014      |
| 2.0      | Revised version of implementation | 1 <sup>st</sup> June 2015      |
| 3.0      | Revised version of implementation | 1 <sup>st</sup> October 2015   |
| 3.1      | Revised version of implementation | 15 <sup>th</sup> March 2018    |
| 3.2      | Revised version of implementation | 15 <sup>th</sup> February 2021 |
| 3.2      | Revised version of implementation | 1 <sup>st</sup> September 2021 |

## 4. GreenRE Assessment Stages

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



## 5. GreenRE Residential Building Rating System

### Overview:

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

- (a) 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.
- (b) Part 2 – Water Efficiency: This category focuses on the selection of fittings and strategies enabling water use efficiency during construction and building operation.
- (c) 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.
- (d) 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.
- (e) 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.
- (f) Part 6- Carbon Emission of Development: This category focuses on the use of carbon calculator to calculate the carbon emission of the development.

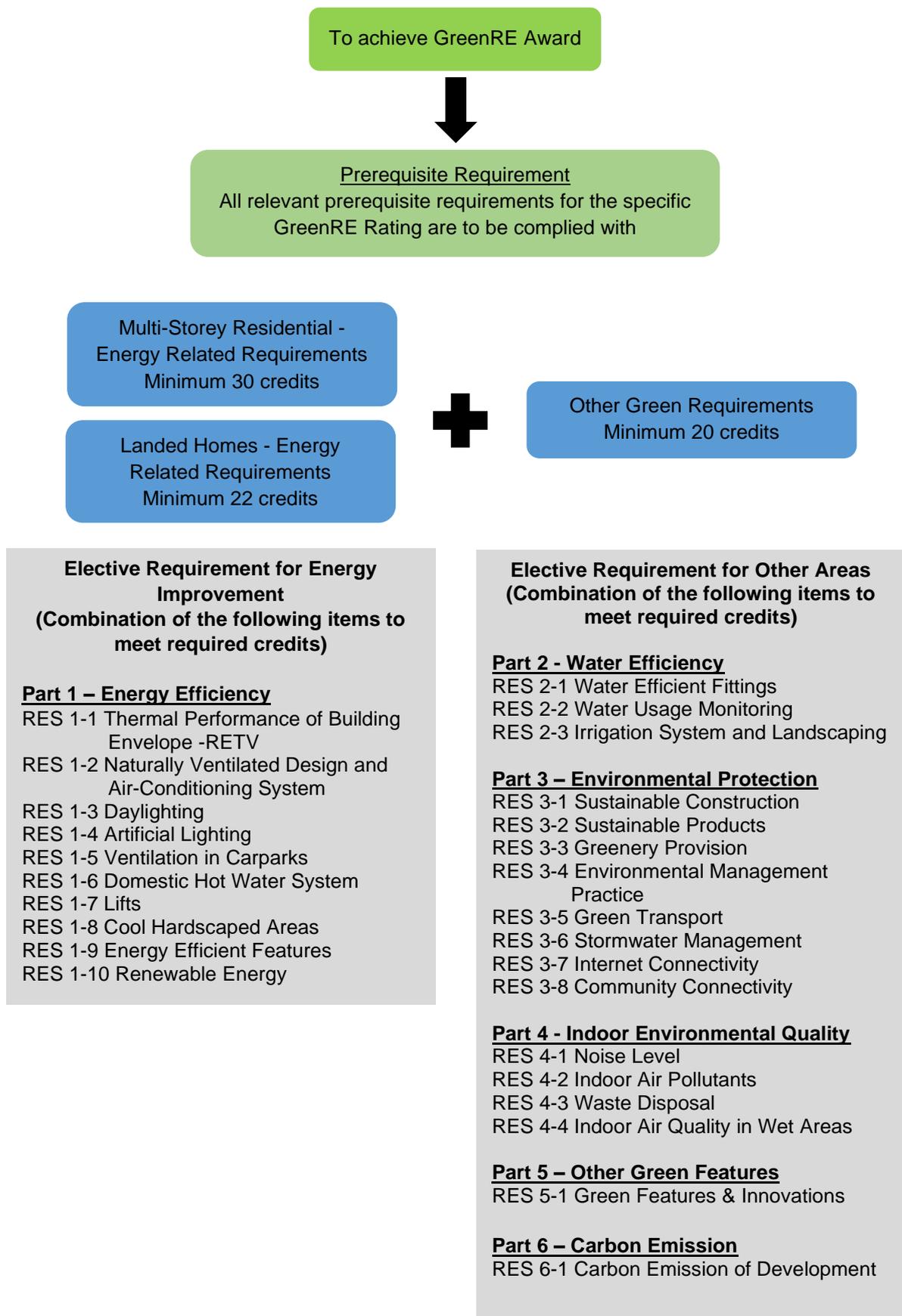
These environment impact categories are broadly classified under two main groups namely (I) Energy Related Requirements and (II) Other Green Requirements.

Energy Related Requirements consist of Part 1- Energy Efficiency where credits are allocated for the various energy efficient designs, practices and features used. For multi-storey residential buildings a minimum of 30 credits must be obtained from this group to be eligible for certification. For landed homes, a minimum of 22 credits must be obtained from this group to be eligible for certification. 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 emission 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:



Credit Allocation:

| Category  |  | Credits Allocations |                  |           |
|---|--|---------------------|------------------|-----------|
|   |  | High- Rise          | Landed           |           |
| <b>(I) Energy Related Requirements</b>                            |  |                     |                  |           |
| Minimum 30 credits  | <b>Part 1: Energy Efficiency</b>                                 |                     |                  |           |
|   | 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                                  | 6                   | 2                |           |
|   | RES 1-6 Domestic Hot Water System                                | 3                   | 3                |           |
|   | RES 1-7 Lifts  | 1                   | 1                |           |
|   | RES 1-8 Cool Hardscaped Areas                                    | 2                   | 2                |           |
|   | RES 1-9 Energy Efficient Features                                | 7                   | 7                |           |
|   | RES 1-10 Renewable Energy  | 15                  | 15               |           |
| <b>Category Score for Part 1 – Energy Efficiency</b>              |  | <b>85 (Max)</b>     | <b>84 (Max)</b>  |           |
| <b>(II) Other Green Requirements</b>                              |  |                     |                  |           |
| Minimum 20 credits  | <b>Part 2: Water Efficiency</b>                                  |                     |                  |           |
|   | RES 2-1 Water Efficient Fittings                                 | 8                   | 8                |           |
|   | RES 2-2 Water Usage Monitoring                                   | 1                   | 1                |           |
|   | RES 2-3 Irrigation System and Landscaping                        | 3                   | 3                |           |
|   | <b>Category Score for Part 2 – Water Efficiency</b>              |                     | <b>12</b>        | <b>12</b> |
|   | <b>Part 3: Environmental Protection</b>                          |                     |                  |           |
|   | RES 3-1 Sustainable Construction                                 | 10                  | 10               |           |
|   | RES 3-2 Sustainable Products                                     | 8                   | 8                |           |
|   | 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 Internet Connectivity                                    | 1                   | 1                |           |
|   | RES 3-8 Community Connectivity                                   | 1                   | 1                |           |
|   | <b>Category Score for Part 3 – Environmental Protection</b>      |                     | <b>46</b>        | <b>46</b> |
|   | <b>Part 4: Indoor Environmental Quality</b>                      |                     |                  |           |
|   | RES 4-1 Noise Level  | 1                   | 1                |           |
|   | RES 4-2 Indoor Air Pollutants                                    | 2                   | 2                |           |
|   | RES 4-3 Waste Disposal   | 1                   | 1                |           |
|   | RES 4-4 Indoor Air Quality in Wet Areas                          | 2                   | 2                |           |
| <b>Category Score for Part 4 – Environmental Quality</b>          |  | <b>6</b>            | <b>6</b>         |           |
| <b>Part 5: Other Green Features</b>                               |  |                     |                  |           |
| RES 5-1 Green Features & Innovations                              | 7  | 7                   |                  |           |
| <b>Category Score for Part 5 – Other Green Features</b>           |  | <b>7</b>            | <b>7</b>         |           |
| <b>Part 6: Carbon Emission of Development</b>                     |  |                     |                  |           |
| RES 6-1 Carbon Emission of Development                            | 3  | 3                   |                  |           |
| <b>Category Score for Part 6 – Carbon Emission of Development</b> |  | <b>3</b>            | <b>3</b>         |           |
| <b>GreenRE Score:</b>   |  | <b>159 (Max)</b>    | <b>158 (Max)</b> |           |

*\*Total score will be rounded to the nearest whole number*

## 6. GreenRE Residential Building Rating System Scoring

| Score        | Rating           |
|--------------|------------------|
| 90 and above | GreenRE Platinum |
| 85 to < 90   | GreenRE Gold     |
| 75 to < 85   | GreenRE Silver   |
| 50 to < 75   | GreenRE Bronze   |

## 7. GreenRE Residential Building Rating System Criteria

### Pre-requisites:

- 1) 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 Gold - RETV of 22 W/m<sup>2</sup> or lower  
GreenRE Platinum - RETV of 20 W/m<sup>2</sup> or lower

- 2) To be eligible for GreenRE Platinum rating,

- It is a requirement to perform ventilation simulation modelling and achieve minimum 70% of the selected typical dwelling units with good natural ventilation by demonstrating a wind velocity of 0.60 m/s. Common areas like staircases and lobbies (excluding those that are located in basement areas) are to be designed as naturally ventilated spaces. Assistance from the 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.
- For landed home projects whereby ventilation simulation modelling is not performed, it is a requirement to achieve  $\geq 16$  credits under RES 1-2 (a) Option 2 (i) and (ii).

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

GreenRE Gold } Air conditioners with Suruhanjaya Tenaga 5-star rating or  
GreenRE Platinum } equivalent

Note: Points scoring and fulfilment of pre-requisite for air-conditioning will be allowed in the following scenarios:

- Provided by developer for all dwelling spaces (i.e living room and bedrooms).
- Provided by developer in either living room or bedrooms AND inclusion in and building user guide.
- Not provided by developer but included as obligation to purchaser AND inclusion in building user guide.

Fulfilment of pre-requisite for air-conditioning without point scoring:

- Included in building user guide

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

- 5) Minimum score under RES 3-1 Sustainable Construction  
 GreenRE Gold  $\geq 3$  credits  
 GreenRE Platinum  $\geq 5$  credits
  
- 6) Minimum score under RES 3-2 Sustainable Products  
 GreenRE Gold  $\geq 3$  credits  
 GreenRE Platinum  $\geq 4$  credits
  
- 7) Provision of Building User Guide and Sustainable Operation and Management Guideline
  
- 8) Calculation of Energy Efficiency Index (EEI) for common area for high rise and landed home (gated and guarded) only
  
- 9) The roof of residential buildings shall not have a thermal transmittance (U-Value) greater than that tabulated in Table 2-1.

**Table 2-1 Maximum U-Value for Roof (W/m<sup>2</sup>K)**

| Roof Weight Group                      | Maximum U-Value (W/m <sup>2</sup> K) |
|--|--------------------------------------|
| Light<br>(Under 50 kg/m <sup>2</sup> ) | 0.4                                  |
| Heavy<br>(Above 50 kg/m <sup>2</sup> ) | 0.6                                  |

| Part 1 - Energy Efficiency  | GreenRE Credits   |
|---|---|
| <p><b><u>RES 1-1 THERMAL PERFORMANCE OF BUILDING ENVELOPE – RETV</u></b></p> <p><b><u>For Multi-storey Residential and Landed Homes</u></b></p> <p>Enhance overall thermal performance of building envelope to minimise heat gain thus reducing the overall cooling load requirement.</p> <p><u>Baseline:</u><br/>Maximum permissible RETV = 25W/m<sup>2</sup></p> <p><u>Prerequisite Requirement:</u><br/>GreenRE Gold - RETV of 22 W/m<sup>2</sup> or lower<br/>GreenRE Platinum - RETV of 20 W/m<sup>2</sup> or lower</p> <p><b><u>For Landed Homes</u></b></p> <p>Lightweight roof U-value ≤ 0.35W/m<sup>2</sup>K /<br/>Heavyweight roof U-value ≤ 0.50W/m<sup>2</sup>K <b>OR</b></p> <p>Lightweight roof U-value ≤ 0.30W/m<sup>2</sup>K /<br/>Heavyweight roof U-value ≤ 0.40W/m<sup>2</sup>K <b>OR</b></p> <p>Lightweight roof U-value ≤ 0.25W/m<sup>2</sup>K /<br/>Heavyweight roof U-value ≤ 0.30W/m<sup>2</sup>K</p> <p><b>and / or</b></p> <p>Provision of hardscaped roof that is finished with materials / finishes with Solar Reflectance Index (SRI) values of 40 <b>OR</b> provision of green roof to reduce local heat island effect.</p> <p>i. 25% of the roof area<br/>ii. 50% of the roof area<br/>iii. 75% of the roof area</p> | <p>3 credits for every reduction of 1 W/m<sup>2</sup> in RETV from the baseline.</p> <p>Credits scored = 75 – [3 x (RETV)]<br/>where RETV ≤ 25 W/m<sup>2</sup></p> <p>(Up to 15 credits)</p> <p>2 credits</p> <p>3 credits</p> <p>4 credits</p> <p>(Up to 4 credits)</p> <p>1 credit<br/>2 credits<br/>3 credits</p> <p>(Up to 3 credits)</p> |

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

(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.

Prerequisite Requirement:

*GreenRE Platinum - Minimum 70% of the selected typical dwelling units with good natural ventilation. Common areas are to be designed as naturally ventilated spaces*

OR

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

(i) Air flow within Dwelling Units

- Building layout design: Proper design of building layout that utilises prevailing wind conditions to achieve adequate cross ventilation.
- Dwelling unit design: Good ventilation in indoor units through sufficient openings

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

Credits scored =  $0.2 \times (\% \text{ of typical units with good natural ventilation})$

(Up to 20 credits)

OR

0.5 credits for every 10% of units with window opening facing north and south directions

Credits scored =  $0.5 \times (\% \text{ of units}/10)$

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

Credits scored =  $0.5 \times (\% \text{ of rooms}/10)$

(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.

**and / or**

Provision of mechanical ceiling fan

Use of ceiling fan as the mechanical cooling system.

*Note (1): For Option 2(ii) credit scoring only allowed if all dwelling units and internal areas are provided with energy efficient cooling system. Credits will be pro-rated accordingly based on area of coverage*

*Note (2): Option 2(ii) details of points scoring and fulfilment of pre-requisite for air-conditioning refer page 36*

*Note (3): Option 2(ii) details of points scoring and fulfilment of pre-requisite for ceiling fan refer page 37*

Prerequisite requirement:

GreenRE Gold } Air-conditioners with  
GreenRE Platinum } ST 5-star rating or equivalent

(b) Natural Ventilation in Common Areas

Design for natural ventilation in following common areas:

- i. Lift lobbies and corridors
- ii. Staircases

Note: Applicable for landed home projects with common areas (e.g club-house, management office etc.)

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 |

|        |            |
|--------|------------|
| 4-Star | 8 credits  |
| 5-Star | 10 credits |

(Capped at 10 credits)

Extent of coverage: At least 80% of the applicable areas

1 credit

1 credit

**RES 1-3 DAYLIGHTING**

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

- 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%)

**For Multi-Storey Residential**

- b) Daylighting in the following common areas:
  - i. Lift lobbies and corridors
  - ii. Staircases (non-bomba only)
  - iii. Carparks

*Note:*

- (a) *Applicable for landed home projects with common areas (e.g club-house, management office etc.)*
- (b) *Simulation or suitable daylight calculation is necessary for occupied space and common area to achieve the minimum daylight factors required.*
- (c) *For common areas, proper control of artificial lighting is required to maximise harvested daylight.*

| <b>Percentage of Habitable Spaces with Adequate Ambient Lighting Level</b> | <b>Credits Allocation</b> |
|--|---------------------------|
| 50% - 75%  | 1                         |
| 76% - 90%  | 2                         |
| >90%   | 3                         |

(Up to 3 credits)

Extent of coverage: At least 80% of the applicable areas

1 credit

1 credit

1 credit

**RES 1-4 ARTIFICIAL LIGHTING**

**For Multi-Storey Residential**

Encourage the use of energy efficient lighting in common areas to minimise energy consumption from lighting usage.

Baseline:

Luminance level stated in MS1525:2019.

0.2 credits for every percentage improvement in the lighting power budget.

Credits scored

$$= 0.2 \times (\% \text{ improvement})$$

(Up to 8 credits)

|  |   |
|--|---|
| <p><b><u>For Landed Homes</u></b><br/>Encourage the use of energy efficient lighting in common areas to minimise energy consumption from lighting usage.</p> <p>Applicable for landed home projects with common areas (e.g club-house, management office etc.)</p>   | <p>0.1 credits for every percentage improvement in the lighting power budget.</p> <p>Credits scored</p> <p>= 0.1 x (% improvement)</p> <p>(Up to 4 credits)</p>   |
| <p><b><u>RES 1-5 VENTILATION IN CARPARKS</u></b></p> <p><b><u>For Multi-Storey Residential</u></b><br/>Encourage the use of energy efficient design and control of ventilation systems in car parks.</p> <p>(a) Car park spaces that are fully naturally ventilated.</p> <p>(b) CO sensors are used to regulate the demand for mechanical ventilation (MV)</p> <p>Note (2): Where there is a combination of different ventilation modes adopted for car park design, the credits scored under this requirement will be prorated accordingly.</p> <p><b><u>For Landed Homes</u></b><br/>Provision of naturally ventilated, covered parking space.</p> | <p>Naturally ventilated carparks – 6 credits</p> <p>Credits scored based on the mode of mechanical ventilation provided</p> <p>Fume extract – 4 credits<br/>MV with or without supply – 3 credits</p> <p>(Up to 6 credits)</p> <p>2 credits</p> |
| <p><b><u>RES 1-6 DOMESTIC HOT WATER SYSTEM</u></b></p> <p>Use of innovative domestic hot water heating system:</p> <p>(a) Gas water heaters or energy efficient heat pump water heaters</p> <p>(b) Solar water heaters</p>   | <p>2 credits</p> <p>3 credits</p> <p>(Up to 3 credits)</p>  |
| <p><b><u>RES 1-7 LIFTS</u></b></p> <p>Encourage the use of lift with energy efficient features such as AC variable voltage and variable frequency (VVVF) motor drive and energy efficient features such as sleep mode.</p>   | <p>1 credit</p>   |

|  |   |
|--|---|
| <p><b><u>RES 1-8 COOL HARDSCAPED AREAS</u></b></p> <p>All hardscaped non-roof areas are to be finished with materials or finishes with a Solar Reflective Index (SRI) value of 29 or more.</p> <p>i. ≥ 50% of non-roof hardscaped area<br/> ii. ≥ 75% of non-roof hardscaped area</p> <p><i>Note: The area of application for % calculation of hardscape material SRI will be for the ground floor site ONLY.</i></p>  | <p>1 credit<br/> 2 credits</p>  |
| <p><b><u>RES 1-9 ENERGY EFFICIENT FEATURES</u></b></p> <p>Encourage the use of energy efficient features that are innovative and have positive environmental impact in term of energy saving.</p> <p>(a) Use of energy efficient equipment or product that are certified by approved local certification body (i.e ST 5-star rated appliances)</p> <p>(b) Use of the following energy efficient features:</p> <ul style="list-style-type: none"> <li>• Heat recovery devices</li> <li>• Regenerative lifts</li> <li>• Thermal Insulation</li> <li>• Calculation of EEI for common areas.</li> <li>• Provision of vertical greenery systems.</li> <li>• Provision of features to facilitate windows being kept open at night and during adverse weather.</li> </ul> | <p>Extent of coverage: At least 90% of the applicable equipment type or product</p> <p>0.5 credits for each eligible certified equipment or product</p> <p>(Up to 2 credits)</p> <p>2 credits for high impact item</p> <p>1 credit for medium impact item</p> <p>0.5 credits for low impact item</p> <p>(Up to 5 credits)</p> |
| <p><b><u>RES 1-10 RENEWABLE ENERGY</u></b></p> <p><b><u>For Multi-storey Residential</u></b></p> <p>Encourage the use of renewable energy sources in buildings such as solar energy.</p>   | <p>3 credits for every 1% replacement of electricity (based on annual electricity consumption exclude household's usage) by renewable energy</p> <p>and / or</p>  |

|   |   |
|---|---|
| <p><b><u>For Landed Homes</u></b><br/>Encourage the use of renewable energy sources in landed homes such as solar energy.</p> | <p>3 credits for every 10% of roof area utilized for solar panels<br/>(Up to 15 credits)</p> <p>3 credits for every 5% replacement of electricity by renewable energy (per house unit)<br/>(Up to 15 credits)</p> <p><i>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).</i></p> |
| <p><b>Part 1 – ENERGY EFFICIENCY<br/>CATEGORY SCORE:</b></p>  | <p>Sum of GreenRE credits obtained from RES 1-1 to 1-10</p>   |

| Part 2 – Water Efficiency   | GreenRE Credits   |                       |  |  |             |                     |                    |                    |                 |                  |
|---|---|-----------------------|--|--|-------------|---------------------|--------------------|--------------------|-----------------|------------------|
| <p><b><u>RES 2-1 WATER EFFICIENT FITTINGS</u></b></p> <p>Encourage the use of water efficient fittings covered under the Water Efficiency Product Labelling Scheme (WEPLS)</p> <ul style="list-style-type: none"> <li>a) Basin taps and mixers</li> <li>b) Flushing cistern</li> <li>c) Shower taps and mixers</li> <li>d) Sink/bib taps and mixers</li> <li>e) Urinals and urinal flush valve</li> <li>f) Showerheads</li> </ul> <p><i>Note: At least 90% of each fitting type must be rated to be able to score for the credits</i></p>                 | <p>Credits scored based on the number and water efficiency rating of the fitting type used</p> <p>(Up to 8 credits)</p> <table border="1" data-bbox="815 539 1383 734"> <thead> <tr> <th colspan="3">Rating Based on WEPLS</th> </tr> <tr> <th>Efficient *</th> <th>Highly Efficient **</th> <th>Most Efficient ***</th> </tr> </thead> <tbody> <tr> <td><b>0.5 credits</b></td> <td><b>1 credit</b></td> <td><b>2 credits</b></td> </tr> </tbody> </table> | Rating Based on WEPLS |  |  | Efficient * | Highly Efficient ** | Most Efficient *** | <b>0.5 credits</b> | <b>1 credit</b> | <b>2 credits</b> |
| Rating Based on WEPLS   |   |                       |  |  |             |                     |                    |                    |                 |                  |
| Efficient *   | Highly Efficient **   | Most Efficient ***    |  |  |             |                     |                    |                    |                 |                  |
| <b>0.5 credits</b>  | <b>1 credit</b>   | <b>2 credits</b>      |  |  |             |                     |                    |                    |                 |                  |
| <p><b><u>RES 2-2 WATER USAGE MONITORING</u></b></p> <p>Provision of private meters to monitor the major water usage such as irrigation, swimming pools and other water features.</p>  | <p>1 credit</p>   |                       |  |  |             |                     |                    |                    |                 |                  |
| <p><b><u>RES 2-3 IRRIGATION SYSTEM AND LANDSCAPING</u></b></p> <p>Provision of suitable systems that utilizes rainwater or recycled water for landscape irrigation and use of plants that require minimal irrigation to reduce potable water consumption.</p> <ul style="list-style-type: none"> <li>(a) Use of non-potable water including rainwater for landscape irrigation.</li> <li>(b) Use of automatic water efficient irrigation system with rain sensor.</li> <li>(c) Use of drought tolerant plants that require minimal irrigation.</li> </ul> | <p>1 credit</p> <p>Extent of Coverage: At least 50% of the landscape areas are served by the system<br/>1 credit</p> <p>Extent of Coverage: At least 50% of the landscape areas<br/>1 credit</p>  |                       |  |  |             |                     |                    |                    |                 |                  |
| <p><b>PART 2 – WATER EFFICIENCY CATEGORY SCORE:</b></p>   | <p>Sum of GreenRE credits obtained from RES 2-1 to 2-3</p>  |                       |  |  |             |                     |                    |                    |                 |                  |

| Part 3 – Environmental Protection  | GreenRE Credits   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
|--|---|---|---------------------------------|------------|-----|---------------|---|-------------|---|----|---|-----|---|---|--------------------|--------|---|--------|---|-------|---|-------|---|-------|---|
| <p><b><u>RES 3-1 SUSTAINABLE CONSTRUCTION</u></b></p> <p>Encourage recycling and the adoption of building designs, construction practices and materials that are environmentally friendly and sustainable.</p> <p>(a) Use of sustainable and recycled materials;</p> <p>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) for super-structural works.</p> <p>(b) Concrete Usage Index (CUI)</p> <p>Encourage more efficient concrete usage for building components.</p> <p><i>Prerequisite Requirement:</i><br/> <i>Minimum score under RES 3-1:</i><br/> <i>GreenRE Gold ≥ 3 credits</i><br/> <i>GreenRE Platinum ≥ 5 credits</i></p> | <table border="1" data-bbox="815 472 1385 790"> <thead> <tr> <th data-bbox="815 472 1190 589">% Replacement of OPC by approved industrial by-products</th> <th data-bbox="1190 472 1385 589">Credits Allocation</th> </tr> </thead> <tbody> <tr> <td data-bbox="815 589 1190 629">10</td> <td data-bbox="1190 589 1385 629">1</td> </tr> <tr> <td data-bbox="815 629 1190 669">20</td> <td data-bbox="1190 629 1385 669">2</td> </tr> <tr> <td data-bbox="815 669 1190 710">30</td> <td data-bbox="1190 669 1385 710">3</td> </tr> <tr> <td data-bbox="815 710 1190 750">40</td> <td data-bbox="1190 710 1385 750">4</td> </tr> <tr> <td data-bbox="815 750 1190 790">&gt;50</td> <td data-bbox="1190 750 1385 790">5</td> </tr> </tbody> </table> <p data-bbox="995 824 1206 857">(Up to 5 credits)</p> <table border="1" data-bbox="815 981 1385 1339"> <thead> <tr> <th data-bbox="815 981 1102 1070">Project CUI (m<sup>3</sup>/m<sup>2</sup>)</th> <th data-bbox="1102 981 1385 1070">Credits Allocation</th> </tr> </thead> <tbody> <tr> <td data-bbox="815 1070 1102 1126">≤ 0.70</td> <td data-bbox="1102 1070 1385 1126">1</td> </tr> <tr> <td data-bbox="815 1126 1102 1182">≤ 0.60</td> <td data-bbox="1102 1126 1385 1182">2</td> </tr> <tr> <td data-bbox="815 1182 1102 1238">≤0.50</td> <td data-bbox="1102 1182 1385 1238">3</td> </tr> <tr> <td data-bbox="815 1238 1102 1294">≤0.40</td> <td data-bbox="1102 1238 1385 1294">4</td> </tr> <tr> <td data-bbox="815 1294 1102 1339">≤0.35</td> <td data-bbox="1102 1294 1385 1339">5</td> </tr> </tbody> </table> <p data-bbox="995 1395 1206 1429">(Up to 5 credits)</p> | % Replacement of OPC by approved industrial by-products | Credits Allocation              | 10         | 1   | 20            | 2 | 30          | 3 | 40 | 4 | >50 | 5 | Project CUI (m <sup>3</sup> /m <sup>2</sup> ) | Credits Allocation | ≤ 0.70 | 1 | ≤ 0.60 | 2 | ≤0.50 | 3 | ≤0.40 | 4 | ≤0.35 | 5 |
| % Replacement of OPC by approved industrial by-products  | Credits Allocation  |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| 10   | 1   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| 20   | 2   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| 30   | 3   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| 40   | 4   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| >50  | 5   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| Project CUI (m <sup>3</sup> /m <sup>2</sup> )  | Credits Allocation  |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| ≤ 0.70   | 1   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| ≤ 0.60   | 2   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| ≤0.50  | 3   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| ≤0.40  | 4   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| ≤0.35  | 5   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| <p><b><u>RES 3-2 SUSTAINABLE PRODUCTS</u></b></p> <p>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.</p> <p><i>Prerequisite Requirement:</i><br/> <i>Minimum score under RES 3-1:</i><br/> <i>GreenRE Gold ≥ 3 credits</i><br/> <i>GreenRE Platinum ≥ 4 credits</i></p>  | <table border="1" data-bbox="815 1547 1385 1850"> <thead> <tr> <th data-bbox="815 1547 1158 1682">Extent of use of environmentally friendly product</th> <th data-bbox="1158 1547 1385 1682">Weightage for Credit Allocation</th> </tr> </thead> <tbody> <tr> <td data-bbox="815 1682 1158 1738">Low impact</td> <td data-bbox="1158 1682 1385 1738">0.5</td> </tr> <tr> <td data-bbox="815 1738 1158 1794">Medium impact</td> <td data-bbox="1158 1738 1385 1794">1</td> </tr> <tr> <td data-bbox="815 1794 1158 1850">High Impact</td> <td data-bbox="1158 1794 1385 1850">2</td> </tr> </tbody> </table> <p data-bbox="826 1917 1374 1984">Credits scored will be based on the extent of coverage and impact.</p> <p data-bbox="995 2007 1206 2040">(Up to 8 credits)</p>  | Extent of use of environmentally friendly product       | Weightage for Credit Allocation | Low impact | 0.5 | Medium impact | 1 | High Impact | 2 |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| Extent of use of environmentally friendly product  | Weightage for Credit Allocation   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| Low impact   | 0.5   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| Medium impact  | 1   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| High Impact  | 2   |   |                                 |            |     |               |   |             |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |

**RES 3-3 GREENERY PROVISION**

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

**For Multi-storey Residential**

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

| 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:  
(i) 50% of non-built-up area as greenery area  
(ii) 60% of non-built-up area as greenery area (2 credits)  
(iii) 75% non-built-up area as greenery area (3 credits)

1 credit  
2 credits  
3 credits  
(Up to 3 credits)

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

(c) Provision of green space above regulatory requirements for entire development  
(i) 5% more green space  
(ii) 10% more green space  
(iii) 15% more green space

1 credit  
2 credits  
3 credits  
(Up to 3 credits)

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

**For Multi-storey Residential and Landed Homes**

(d) Restoration of trees on site, conservation or relocation of existing trees on site. (at least 20%)

1 credit

|   |   |
|---|---|
| <p>(e) Provision of compost bins to recycle organic waste to meet at least 30% of landscape fertilizer needs.</p>   | <p>1 credit</p>   |
| <p><b><u>RES 3-4 ENVIRONMENTAL MANAGEMENT PRACTICE</u></b></p> <p>Encourage the adoption of environmental friendly practices during construction and building operation.</p> <p>(a) Implement effective environmentally friendly programmes including monitoring and setting targets to minimise energy use, water use and construction waste during construction stage.</p> <p>(b) Main builder has good track records in completing internationally recognized accredited Green Buildings and adoption of sustainable, environmentally friendly and considerate practices during construction.</p> <p>(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).</p> <p>(d) To perform IBS content scoring based on CIDB IBS scoring scheme.</p> <p>(e) Developer, main builder, M&amp;E consultant and architect are ISO 14000 certified.</p> <p>(f) Project team comprises Certified GreenRE Manager/ Green Mark Manager</p> <p>(g) Provision of building users' guide with details of the environmental friendly facilities and features within the building and their uses in achieving the intended environment performance during building operation.</p> | <p>1 credit</p> <p>1 credit</p> <p>1 credit</p> <p>1 credit for IBS score <math>\geq</math> 50%<br/>2 credits for IBS score <math>\geq</math> 70%</p> <p>0.25 credit each<br/>(Up to 1 credit)</p> <p>1 credit for Certified GRM/ GMM</p> <p>1 credit</p> |

|   |   |
|---|---|
| <p>(h) Provision of Sustainable Operation and Management Guideline (SOMG) and a briefing to the building management team.</p> <p>(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.</p>   | <p>1 credit</p> <p>1 credit</p>   |
| <p><b><u>RES 3-5 GREEN TRANSPORT</u></b></p> <p>Promote environmental friendly transport options and facilities to reduce pollution from individual car use.</p> <p>(a) Good access (&lt;800m walking distance) to public transport networks such as MRT/LRT stations or bus stops.</p> <p>(b) Provision of covered walkway to facilitate connectivity and the use of public transport.</p> <p>(c) Provision of infrastructure for electric charging stations to at least 10% of available parking spaces.</p> <p>(d) Provision of electric vehicle charging stations and priority carparking bays within the development.</p> <p>(e) Provision of covered / sheltered bicycles parking bays with rack / bar.</p> | <p>1 credit</p> <p>1 credit</p> <p>1 credit</p> <p>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)</p> <p>1 credit</p> <p>Credits scored based on the number of bicycle parking bays provided.</p> <p>1 credit for the provision of <math>\geq 10\%</math> x number of dwelling units</p> <p>0.5 credits for the provision <math>\geq 5\%</math> x number of dwelling units</p> |

|  |  |
|--|--|
| <p><b><u>RES 3-6 STORMWATER MANAGEMENT</u></b></p> <p>Provision of infiltration features or design features for new development and redevelopment to control quantity of stormwater run-off</p> <p>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.</p>  | <p>Reduce post development stormwater peak discharge rate and quantity from exceeding pre-development peak discharge rate and quantity:</p> <p>5 - 15% - 1 credit</p> <p>16 - 25% - 2 credits</p> <p>&gt; 25% - 3 credits</p> <p>(Up to 3 credits)</p> |
| <p><b><u>RES 3-7 INTERNET CONNECTIVITY</u></b></p> <p>To provide infrastructure for internet connectivity to meet requirements of high-speed internet service providers in all dwelling units.</p>   | <p>1 credit</p>  |
| <p><b><u>RES 3-8 COMMUNITY CONNECTIVITY</u></b></p> <p>Encourage development in urban area with existing infrastructure to minimise the use of private mode of transportation.</p> <p>Basic Services include, but are not limited to:</p> <ul style="list-style-type: none"> <li>• Bank</li> <li>• Beauty</li> <li>• Laundry</li> <li>• Day care</li> <li>• Fire Station</li> <li>• Hardware</li> <li>• Convenience/ Grocery</li> <li>• School</li> <li>• Clinic</li> <li>• Library</li> <li>• Police station</li> <li>• Park</li> <li>• Restaurant</li> </ul> | <p>1 credit can be scored for project located within 1km (walking distance) of at least 10 Basic Services.</p>   |
| <p><b>PART 3 – ENVIRONMENTAL PROTECTION CATEGORY SCORE:</b></p>  | <p>Sum of GreenRE credits obtained from RES 3-1 to 3-8</p>   |

| Part 4 – Indoor Environmental Quality   | GreenRE Credits  |
|---|--|
| <p><b><u>RES 4-1 NOISE LEVEL</u></b></p> <p>Building is designed to achieve ambient internal noise level as specified:</p> <ul style="list-style-type: none"> <li>• 55 dB (6am – 10pm) L<sub>Aeq</sub></li> <li>• 45 dB (10pm – 6am) L<sub>Aeq</sub></li> </ul>   | <p>1 credit</p>  |
| <p><b><u>RES 4-2 INDOOR AIR POLLUTANTS</u></b></p> <p>Minimise airborne contaminants, mainly from inside sources to promote a healthy indoor environment.</p> <p>(a) Use of low volatile organic compounds (VOC) paints certified by approved local/ international certification body.</p> <p>(b) Use of environmentally friendly adhesives certified by approved local/ international certification body.</p>    | <p>Extent of Coverage: At least 90% of the total internal wall areas<br/>1 credit</p> <p>Extent of Coverage: At least 90% of the applicable areas<br/>1 credit</p>   |
| <p><b><u>RES 4-3 WASTE DISPOSAL</u></b></p> <p><b><u>For Multi-storey Residential</u></b><br/>Minimise airborne contaminants from waste by locating refuse chutes or waste disposal area at open ventilation areas such as service balconies or common corridors.</p> <p><b><u>For Landed Homes</u></b><br/>Provision of space that is naturally ventilated in a convenient location for kerbside collection.</p> | <p>1 credit</p> <p>1 credit</p>  |
| <p><b><u>RES 4-4 INDOOR AIR QUALITY IN WET AREAS</u></b></p> <p>Provision for adequate natural ventilation and day lighting in wet areas i.e. kitchens, bathroom and toilets</p>  | <p>Credits scored based on the % of applicable areas with such provision</p> <p>2 credits for more than 90% of all applicable areas.</p> <p>1 credit for at least 50% to 90% of all applicable areas.</p> <p>(Up to 2 credits)</p> |
| <p><b>PART 4 – INDOOR ENVIRONMENTAL QUALITY CATEGORY SCORE:</b></p>   | <p>Sum of GreenRE credits obtained from RES 4-1 to 4-4</p>   |

| Part 5 – Other Green Features  | GreenRE Credits   |
|--|---|
| <p><b><u>RES 5-1 GREEN FEATURES &amp; INNOVATIONS</u></b></p> <p>Encourage the use of green features that are innovative and have positive environment impact.</p> <p>Examples:</p> <ul style="list-style-type: none"> <li>• Self-cleaning facade system</li> <li>• Integrated basin/cistern pedestal system</li> <li>• Grey water recycling system</li> <li>• Dual chute system</li> <li>• Calculation of Concrete Usage Index (CUI)</li> <li>• Conservation of existing building structure</li> <li>• Water efficient washing machines with “Good” rating and above.</li> <li>• Etc</li> </ul> | <p>2 credits for high impact item</p> <p>1 credit for medium impact item</p> <p>0.5 credit for low impact item</p> <p>(Up to 7 credits)</p> |
| <p><b>PART 5 – OTHER GREEN FEATURES CATEGORY SCORE:</b></p>  | <p>Sum of GreenRE credits obtained from RES 5-1</p>   |

| Part 6 – Carbon Footprint of Development  | GreenRE Credits  |
|---|--|
| <p><b><u>RES 6-1 CARBON FOOTPRINT OF DEVELOPMENT</u></b></p> <p>Recognise the carbon emission based on operational carbon footprint computation of the building comprising energy and water consumption</p> <p>To identify carbon debt and quantify environmental impact and embodied energy.</p>   | <p>1 credit</p> <p>1 credit – Carbon footprint calculation of glass, steel and concrete.</p> <p>0.25 credits for every additional material declared up to 1 credit.</p> <p>(up to 2 credits)</p> |
| <p><b>PART 6 – CARBON FOOTPRINT OF DEVELOPMENT</b><br/><b>CATEGORY SCORE:</b></p>   | <p>Sum of GreenRE credits obtained from RES 6-1</p>  |
| <p><b>GreenRE Score (Residential Building &amp; Landed Home)</b></p> <p>GreenRE Score (RES) = <math>\sum</math>Category score [ (Part 1-Energy Efficiency)+<br/>(Part 2-Water Efficiency)+<br/>(Part 3-Environmental Protection)+<br/>(Part 4-Indoor Environmental Quality)+<br/>(Part 5-Other Green Features)+<br/>(Part 6-Carbon Emission Development)]</p> <p>Where:<br/>Category Score for Part 1 <math>\geq</math> 30 credits (Multi-Storey Residential) <b>or</b> Part 1 <math>\geq</math> 22 credits (Landed Homes) and <math>\sum</math> Category score for Part 2 to Part 6 <math>\geq</math> 20 credits</p> |  |

## (I) Energy Related Requirements

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### Part 1- Energy Efficiency

**RES 1-1 Thermal Performance of Building Envelope-RETV**

**RES 1-2 Naturally Ventilated Design and  
Air-Conditioning 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

|                          |   |
|--------------------------|---|
| <b>Objectives</b>        | Enhance overall thermal performance of building envelope to minimise heat gain thus reducing the overall cooling load requirement.  |
| <b>Applicability</b>     | Applicable to all type of residential buildings; multi-storey and landed home   |
| <b>Baseline Standard</b> | <p><u>For all Residential Buildings</u><br/> Maximum permissible RETV = 25 W/m<sup>2</sup><br/> (RETV stands for Residential Envelope Transmittance Value.)</p> <p>The computation of RETV shall be based on the methodology specified in the Code on Envelope Thermal Performance for Building issued by BCA.</p> <p>For Landed Homes Only</p> <p>Lightweight roof U-value shall be <math>\leq 0.4\text{W/m}^2\text{K}</math> / Heavyweight roof U-value shall be <math>\leq 0.6\text{ W/m}^2\text{K}</math> 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.</p>   |
| <b>Requirements</b>      | <p><u>For all Residential Buildings</u><br/> Up to 15 credits can be scored for building envelope with better thermal performance than the baseline standard:</p> <p>3 credits for every reduction of 1 W/m<sup>2</sup> in RETV from the baseline.</p> <p>Credits scored = <math>75 - [3 \times (\text{RETV})]</math> where <math>\text{RETV} \leq 25\text{ W/m}^2</math></p> <p>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.</p> <p>Refer to BCA Code on Envelope Thermal for building for appropriate solar correction factor specific for RETV</p> <p>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.</p> |

|                                  |   |
|----------------------------------|---|
|                                  | <p>That is:<br/> <math>RET_{V \text{ Weighted average}} = \sum (RET_{V \text{ bldg}} \times A_{\text{bldg}}) / A_{\text{devt}}</math></p> <p>Where:<br/> <math>RET_{V \text{ bldg}}</math> = RETV for a residential building (W/m<sup>2</sup>)<br/> <math>A_{\text{bldg}}</math> = Summation of all façade areas that enclose all living rooms, dining rooms, study rooms and bedrooms of a residential building. (m<sup>2</sup>)<br/> <math>A_{\text{devt}}</math> = Summation of total applicable façade areas of all residential buildings within the development (m<sup>2</sup>) (i.e. <math>\sum A_{\text{bldg}}</math>)</p> <p><u>For Landed Homes Only</u><br/> Up to 4 credits can be scored for improvement in roof U-value beyond baseline requirement of MS-2680:2017.</p> <p>Up to 3 credits can be scored for provision of cool hardscaped roof area.</p>  |
| <b>Prerequisite Requirements</b> | GreenRE Gold - RETV of 22 W/m <sup>2</sup> or less<br>GreenRE Platinum - RETV of 20 W/m <sup>2</sup> or less  |
| <b>Documentary Evidences</b>     | <ul style="list-style-type: none"> <li>• Site plan.</li> <li>• Architectural elevation drawings showing the composition of the different façade or wall systems that are relevant for the computation of RETV.</li> <li>• Architectural plan layouts and elevation showing the living rooms, dining rooms, study rooms and bedrooms.</li> <li>• Glazing specification showing the U-value, SC value and VLT.</li> <li>• Window and door schedules.</li> <li>• Detailed area (m<sup>2</sup>) tabulation of fenestration and wall for every façade.</li> <li>• Calculation of U-value for all type of external walls.</li> <li>• Calculation of U-value for roof.</li> <li>• Calculation of the Shading Coefficient (SC2) for external shading device.</li> <li>• Technical specifications showing SRI value of hardscape roof.</li> <li>• Roof layout with demarcation of hardscape roof or green roof.</li> <li>• RETV calculation for each facing wall and its summary.</li> </ul> |
| <b>References</b>                | Code on Envelope Thermal Performance for Building issued by BCA.  |
| <b>Worked Example 1-1</b>        | <p><u>Example 1</u></p> $RET_{V} = 22 \text{ W/m}^2$<br>Credits scored = $75 - [3 \times (RET_{V})]$<br>= $75 - [3 \times (22)]$<br>= 9 credits<br>Therefore, credits scored should be 9 credits <p><u>Example 2</u></p>  |

$$\text{RETV} = 19 \text{ W/m}^2$$

$$\begin{aligned} \text{Credits scored} &= 75 - [3 \times (\text{RETV})] \\ &= 75 - [3 \times (19)] \\ &= 18 \text{ credits} > 15 \text{ credits (max)} \end{aligned}$$

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:

$$\begin{array}{l} \text{RETV}_{\text{bldg1}} = 20 \text{ W/m}^2 \quad A_{\text{bldg}} = 4000 \text{ m}^2 \\ \text{RETV}_{\text{bldg2}} = 25 \text{ W/m}^2 \quad A_{\text{bldg}} = 3600 \text{ m}^2 \\ \text{RETV}_{\text{bldg3}} = 19 \text{ W/m}^2 \quad A_{\text{bldg}} = 5000 \text{ m}^2 \end{array} \quad \left. \vphantom{\begin{array}{l} \text{RETV}_{\text{bldg1}} \\ \text{RETV}_{\text{bldg2}} \\ \text{RETV}_{\text{bldg3}} \end{array}} \right\} \begin{array}{l} A_{\text{devt}} = 4000 + 3600 + 5000 \\ = 12600 \text{ m}^2 \end{array}$$

Therefore;

$$\begin{aligned} \text{RETV}_{\text{Weighted average}} &= \sum (\text{RETV}_{\text{bldg}} \times A_{\text{bldg}}) / A_{\text{devt}} \\ &= \frac{(\text{RETV}_{\text{bldg1}} \times A_{\text{bldg1}}) + (\text{RETV}_{\text{bldg2}} \times A_{\text{bldg2}}) + (\text{RETV}_{\text{bldg3}} \times A_{\text{bldg3}})}{A_{\text{devt}}} \\ &= \frac{(20 \times 4000) + (25 \times 3600) + (19 \times 5000)}{12600} \\ &= 21.03 \text{ W/m}^2 \end{aligned}$$

$$\begin{aligned} \text{Credits scored} &= 75 - [3 \times (\text{RETV})] \\ &= 75 - [3 \times (21.03)] \\ &= 11.91 \text{ credits} \end{aligned}$$

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**

|                          |   |
|--------------------------|---|
| <b>Objectives</b>        | Enhance building design to achieve good natural ventilation for better indoor comfort or through the use of better efficient air-conditioners if needed.  |
| <b>Applicability</b>     | Applicable to all dwelling units within the development.  |
| <b>Baseline Standard</b> | <p>1-2 (a) Option 1 - Ventilation simulation modelling and analysis shall be based on the methodology specified in Appendix A – Ventilation Simulation Methodology and Requirements.</p> <p>1-2 (a) Option 2(ii) – As specified under the Energy Commission (Suruhanjaya Tenaga) for air-conditioners and/or mechanical cooling fans.</p>   |
| <b>Requirements</b>      | <p><u>1-2 (a) Dwelling Unit Indoor Comfort</u></p> <p><u>For Option 1 – Ventilation Simulation Modelling and Analysis</u><br/>Up to 20 credits can be scored for the use of ventilation simulation modelling &amp; analysis or wind tunnel testing to identify the most effective building design and layout to achieve good natural ventilation for all unit types.</p> <p>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 most number of units.</p> <p>The units are deemed to have good natural ventilation if the area-weighted average wind velocity within the unit is not less than 0.60 m/s based on the ventilation simulation analysis.</p> <p>The percentage of units achieving good natural ventilation is given by:</p> $\frac{\sum(\text{No. of Selected Units for Each Layout} \times \text{Area-Weighted Average Wind Velocity}) \times 100\%}{\text{Total Number of Selected Units} \times 0.60 \text{ m/s}}$ <p>0.2 credit for every percentage of typical units with good natural ventilation</p> <p>Credits scored = 0.2 x (% of typical units with good natural ventilation)</p> <p><u>For Option 2 – Ventilation Design (without the use of ventilation simulation modelling) and use of Energy Efficient Cooling System</u><br/>Up to 10 credits can be scored for the following design</p> <p><u>Option 2(i) Air flow within Dwelling Units</u></p> <ul style="list-style-type: none"> <li>• <b>Building layout design</b> that utilises prevailing wind conditions to achieve adequate cross ventilation.</li> </ul> <p>0.5 credit for every 10% of units with window opening facing north <b><u>AND</u></b></p> |

south directions

Credits scored =  $0.5 \times (\% \text{ of units}/10)$

- **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 =  $0.5 \times (\% \text{ of rooms}/10)$

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.

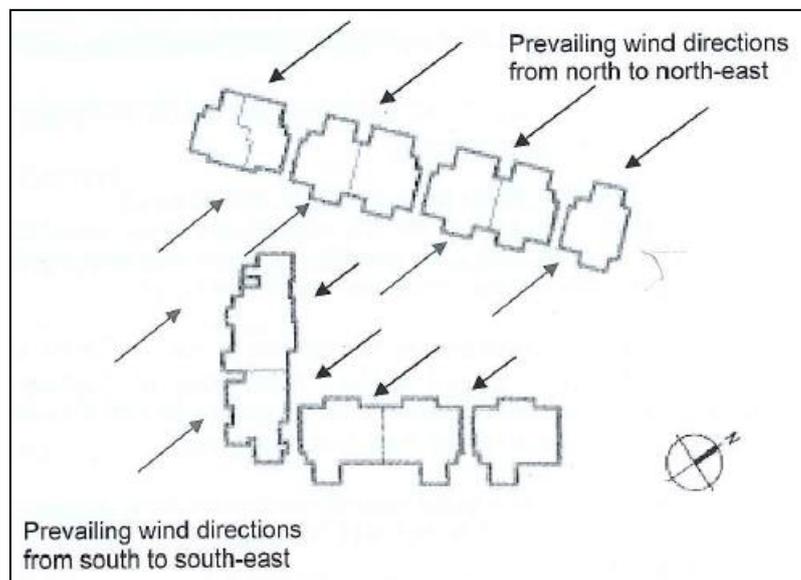
### **Building Layout Design**

It is not necessary for the window openings to be located perpendicularly to the prevailing wind direction (N-S). Only window adjoining the dwelling spaces and kitchen to be considered. Window adjoining toilets/ bathroom and store room will not be considered

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

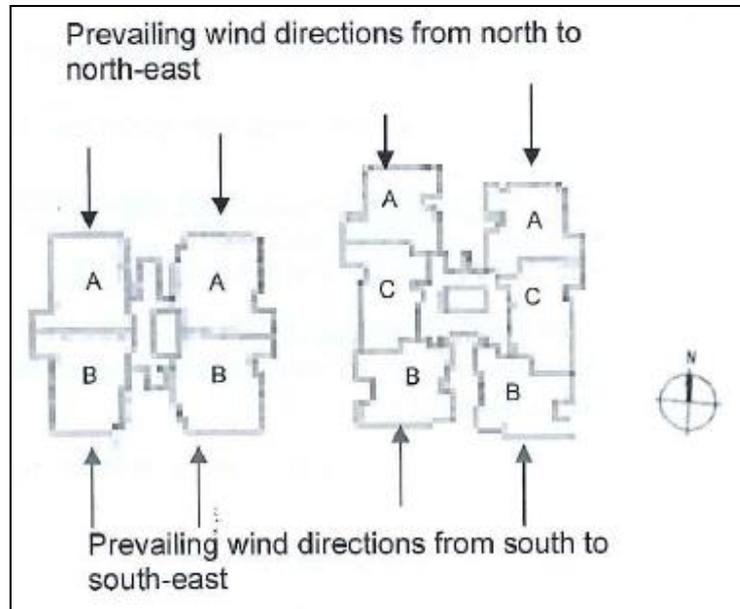
An oblique angle is considered acceptable as illustrated (Refer Illustration 1-2.1 to 1-2.4).

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



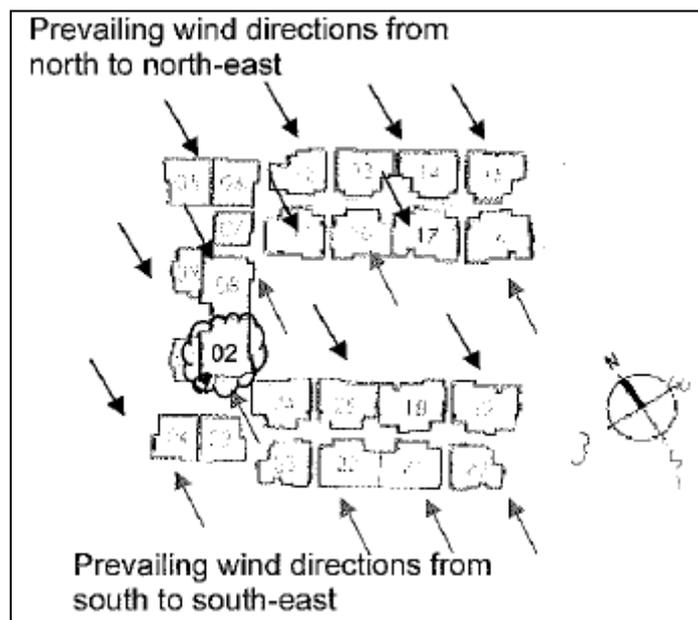
Building layout showing all dwelling units with window openings facing the north and south direction. In this instance, all units can be considered meeting the requirement 1-2(a) Option 2(i).

**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)

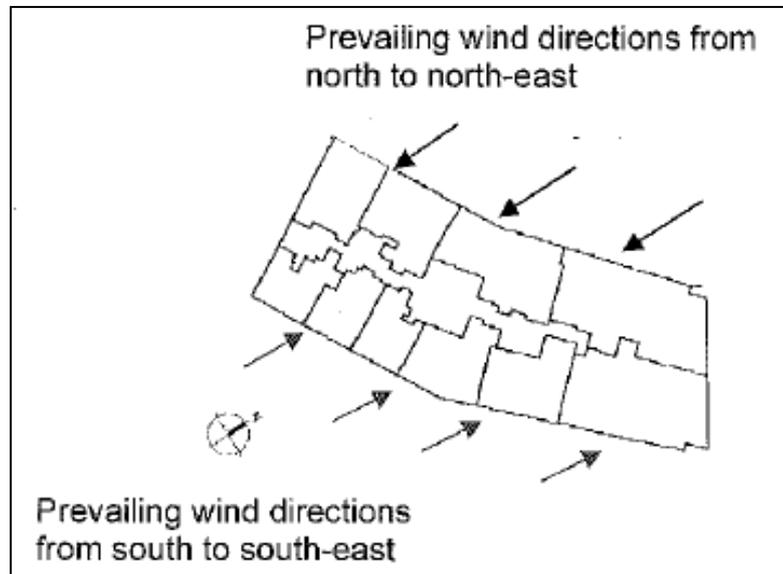
**Illustration 1-2.3: Building layout design that facilitate cross ventilation**



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)

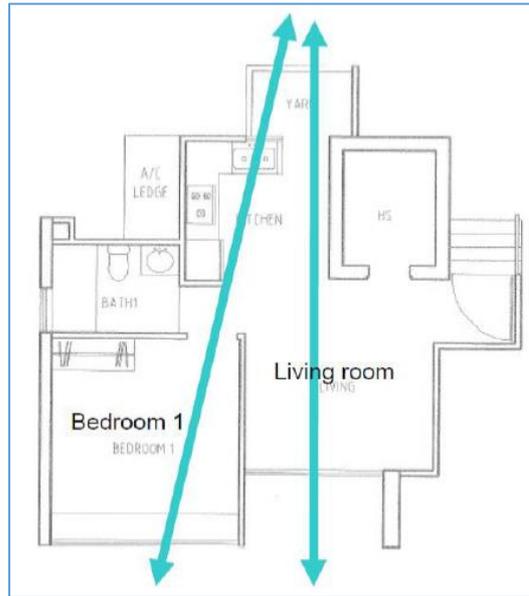
**Dwelling Unit Design**

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 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 no more than two straight lines (one turn only), from the middle of one opening to the other. The angle of the cross-ventilation path must be no greater than 90°. The maximum distance between the inlet and outlet for adequate cross ventilation is  $\leq 12\text{m}$ .

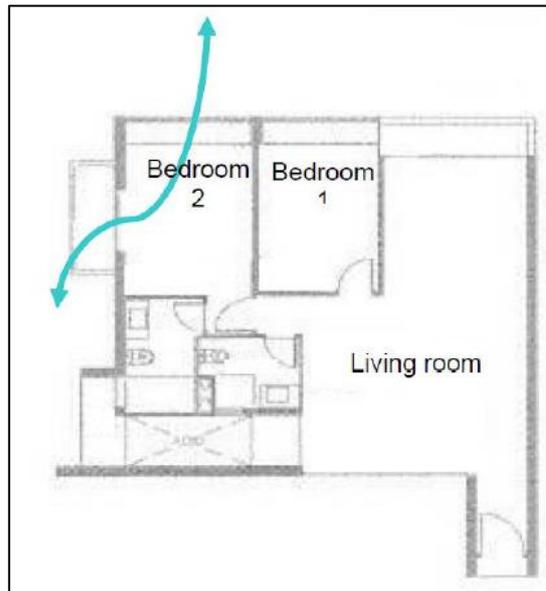
The total openable window area in aggregate should not be less than 1/8th of the total usable area of the room. The minimum opening size (i.e either inlet or outlet) shall be 1/20th of the total usable area of the room.

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



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 1-2.6: Dwelling unit design that facilitates true cross ventilation**



Dwelling unit layout showing bedroom 2 which is considered to have true cross ventilation.

**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:

**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           | ≥5.30               |
| 4           | 4.6 ≤ CSPF ≤ 5.30   |
| 3           | 3.3 ≤ CSPF ≤ 3.30   |

**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 | Tested CSPF (Wh/Wh) |
|-------------|---------------------|
| 5           | ≥5.10               |
| 4           | 4.0 ≤ CSPF ≤ 5.10   |
| 3           | 3.1 ≤ CSPF ≤ 4.0    |

|        |           |
|--------|-----------|
| 4-Star | 4 credits |
| 5-Star | 8 credits |

*Note (1): Option 2(ii) points scoring and fulfilment of pre-requisite for air-conditioning will be allowed in the following scenarios:*

- *Provided by developer for all dwelling spaces (i.e living room and bedrooms).*
- *Provided by developer in either living room or bedrooms AND inclusion in building user guide.*
- *Not provided by developer but included as a clause in sales and purchase agreement AND inclusion in building user guide.*

*Fulfilment of pre-requisite for air-conditioning without point scoring:*

- *Included in building user guide*

**Table 1-2.3: Mechanical ceiling fan, electrically driven: Minimum COP**

| Star rating | COP         |
|-------------|-------------|
| 5           | ≥3.00       |
| 4           | 2.74 – 2.99 |

Note:

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

$$\text{COP} = \frac{\text{Air Delivery} \left( \frac{\text{m}^3}{\text{min}} \right)}{\text{Input Power (W)}}$$

|        |            |
|--------|------------|
| 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): for Option 2(ii) points scoring and fulfilment of pre-requisite for ceiling fans as follows:*

- *Must be installed by developer AND included in building user guide.*
- *Points will be pro-rated based on % of dwelling spaces applied.*

*Fulfilment of pre-requisite for ceiling fan without point scoring:*

- *Included in building user guide.*

*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**

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 staircases areas 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 70% of the selected typical dwelling units must have a weighted average wind velocity of 0.60 m/s. Other than the dwelling units, common areas like staircases and lobbies (excluding those that are located 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

|                                     |  |
|-------------------------------------|--|
| <p><b>Documentary Evidences</b></p> | <p><u>For 1-2(a) Option 1 - Ventilation Simulation Modelling</u></p> <ul style="list-style-type: none"> <li>• Printouts of inputs/variables used for the ventilation simulation software.</li> <li>• All related architectural plan layout used for the ventilation simulation software.</li> <li>• Ventilation simulation or wind tunnel testing reports summarising the analysis and modelling results for each typical space as well as the recommendations for design.</li> <li>• Calculation showing the percentage of units achieving good natural ventilation in the prescribed tabulated format.</li> </ul> <p><u>For 1-2(a) Option 2(i) - Air Flow within Dwelling Units</u></p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Schedules showing the total number of units in the development and those with window openings facing the north and south direction.</li> <li>• Schedules showing the total number of living rooms and bedrooms in the development and those with true cross ventilation.</li> <li>• Calculation showing the percentage of living rooms and bedrooms of dwelling units with true cross ventilation in the prescribed tabulated format.</li> </ul> <p><u>For 1-2(a) Option 2(ii) – Provision of Energy Efficient Cooling System</u></p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Schedule of air-conditioners and/or mechanical ceiling fan showing the numbers, types and the approved rating from the MS 1525:2019 or Singapore Energy Labelling Scheme.</li> <li>• All related drawings showing the air-conditioning system and/or mechanical ceiling fan used.</li> <li>• Technical product information of the air-conditioners and/or mechanical ceiling fan showing the Coefficient of Performance (COP).</li> </ul> <p><u>For 1-2(b) – Natural Ventilation in Common Areas</u></p> <ul style="list-style-type: none"> <li>• Plan layouts showing the applicable common areas and confirmation that they are designed to be naturally ventilated.</li> <li>• Calculation showing the percentage of total applicable common areas with good natural ventilation design.</li> </ul> |
| <p><b>References</b></p>            | <ol style="list-style-type: none"> <li>1. MS 1525:2019 –Energy Efficiency and Use of Renewable Energy for Non-Residential Building - Code of Practice.</li> <li>2. MS 2680:2017 – Energy Efficiency and Use of Renewable Energy for Residential Building – Code of Practice</li> <li>3. For air-conditioner / mechanical ceiling fan rating, can visit Energy Commission (Suruhanjaya Tenaga) <a href="http://www.st.gov.my">www.st.gov.my</a></li> </ol>  |

**Worked 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 most 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.

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

| Dwelling Units Layouts / Types           |                   | No. of Units (A) | Area Weighted Average Wind Velocity (B) |
|--|-------------------|------------------|---|
| 1  | Typical Layout A  | 80               | 0.60                                    |
| 2  | Typical Layout B  | 30               | 0.60                                    |
| 3  | Typical Layout C  | 20               | 0.70                                    |
| 4  | Typical Layout D  | 20               | 0.50                                    |
| 5  | Typical Layout E  | 20               | 0.40                                    |
| 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*

Percentage of units achieving good natural ventilation is given by:

$$= \frac{\sum(A \times B)}{C \times 0.60 \text{ m/s}} \times 100\%$$

$$= \frac{(80 \times 0.60) + (30 \times 0.60) + (20 \times 0.70) + (20 \times 0.5) + (20 \times 0.40)}{170 \times 0.60 \text{ m/s}} \times 100\%$$

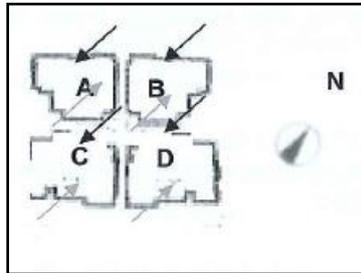
$$= 96\%$$

Credits scored for 1-2(a) Option 1 = 0.2 x 96% = 19.2 credits

**Worked 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.



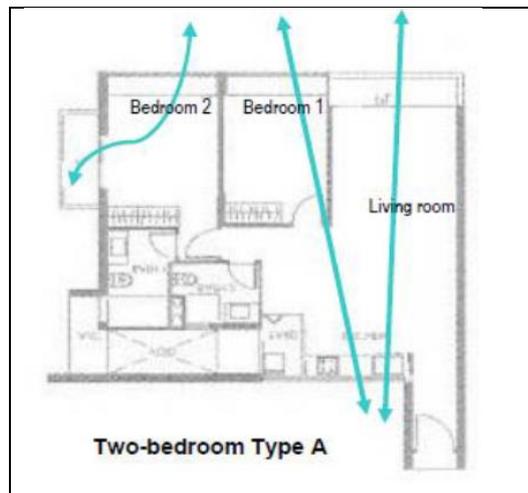
**Building Layout Design**

Total no. of units in the developments = 40

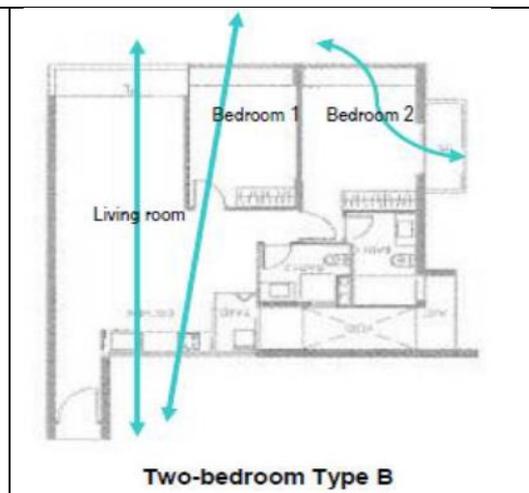
Total units with all window openings facing north and south directions = 40

% of units with window openings facing north and south directions =  $40/40 \times 100\%$

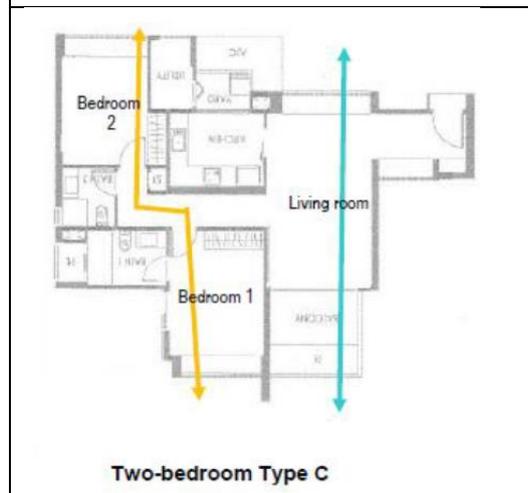
$$\begin{aligned} \text{Credits scored} &= 0.5 \times (\% \text{ unit}/10) \\ &= 0.5 \times (100/10) \\ &= \mathbf{5 \text{ credits}} \end{aligned}$$



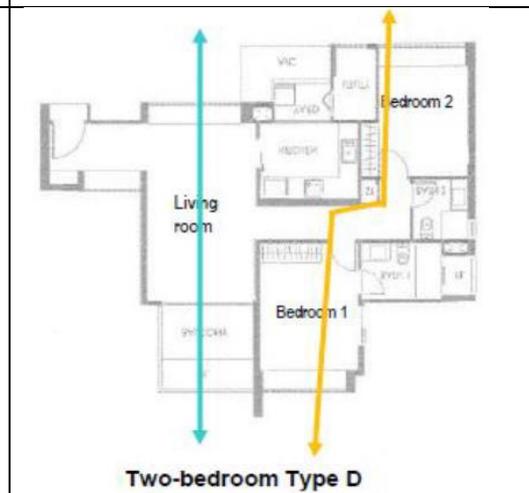
The living room, bedroom 1 and bedroom 2 are considered to have true cross ventilation.



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**

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

| 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  |
| <b>Total:</b>         |                  |   |  | <b>60</b>   |

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 =  $60/120 \times 100\%$   
= 50%

Credits scored =  $0.5 \times (\% \text{ rooms}/10)$   
=  $0.5 \times (50/10)$   
= **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**

**Worked 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**

| <b>Objectives</b>   | Encourage design that optimises the use of effective day lighting to reduce energy use for artificial lighting.   |   |                    |           |   |           |   |      |   |
|---|---|---|--------------------|-----------|---|-----------|---|------|---|
| <b>Applicability</b>  | 1-3(a) Applicable to all normally occupied areas within the development.<br><br>1-3(b) Applicable to all common areas within the development.   |   |                    |           |   |           |   |      |   |
| <b>Baseline Standard</b>  | 1-3(a) The minimum illuminance level for day lighting shall be in accordance with MS 2680:2017.   |   |                    |           |   |           |   |      |   |
| <b>Requirements</b>   | <p>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.</p> <p>The scoring will be based on percentage of habitable spaces with adequate ambient lighting level.</p> <p style="text-align: center;"><b>Table 1-3.1: Credits allocation according to Habitable Spaces</b></p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Percentage of Habitable Spaces with Adequate Ambient Lighting Level</th> <th style="text-align: center;">Credits Allocation</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">50% - 75%</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;">76% - 90%</td> <td style="text-align: center;">2</td> </tr> <tr> <td style="text-align: center;">&gt;90%</td> <td style="text-align: center;">3</td> </tr> </tbody> </table> <p>1-3(b) (i) 1 credit for provision of day lighting for lift lobbies and corridors.</p> <p>1-3(b) (ii) 1 credit for provision of day lighting for staircases.</p> <p>1-3(b) (iii) 1 credit for provision of day lighting for car parks.</p> <p>Note:</p> <ul style="list-style-type: none"> <li>(a) Simulation or suitable daylight calculation is necessary for occupied space and common area to achieve the minimum daylight factors required.</li> <li>(b) For common areas, artificial lighting circuit schematics are necessary as documentary to proof design that allows controllability to maximise harvested daylight.</li> </ul> | Percentage of Habitable Spaces with Adequate Ambient Lighting Level | Credits Allocation | 50% - 75% | 1 | 76% - 90% | 2 | >90% | 3 |
| Percentage of Habitable Spaces with Adequate Ambient Lighting Level | Credits Allocation  |   |                    |           |   |           |   |      |   |
| 50% - 75%   | 1   |   |                    |           |   |           |   |      |   |
| 76% - 90%   | 2   |   |                    |           |   |           |   |      |   |
| >90%  | 3   |   |                    |           |   |           |   |      |   |

| <b>Documentary Evidences</b> | <p><u>For 1-3(a)</u></p> <ul style="list-style-type: none"> <li>• Printouts of inputs/variables used for the daylight simulation software.</li> <li>• All related architectural plan layout used for the daylight simulation software showing the fenestration areas for each habitable space.</li> <li>• Schedules showing the total number of living and dining areas in the development and those with effective daylighting.</li> <li>• Daylight simulation report summarizing the analysis and modelling results for each living and dining area that meets the requirement or any relevant calculation.</li> </ul> <p><u>For 1-3(b)</u></p> <ul style="list-style-type: none"> <li>• Extracts of the tender specification or drawings showing the use of day lighting for lift lobbies and corridors, staircases and car parks where applicable.</li> <li>• Calculation showing the percentage of total applicable common areas with effective daylighting.</li> <li>• Daylight simulation report summarizing the analysis and modelling results for each applicable common area.</li> </ul>  |        |        |        |        |        |               |        |               |        |     |     |     |    |    |    |     |        |     |     |     |    |    |    |     |        |     |     |     |     |    |    |     |        |     |     |     |     |    |    |     |        |     |     |     |     |    |    |     |        |     |     |     |     |    |     |     |        |     |     |   |     |     |     |     |
|------------------------------|---|--------|--------|--------|--------|--------|---------------|--------|---------------|--------|-----|-----|-----|----|----|----|-----|--------|-----|-----|-----|----|----|----|-----|--------|-----|-----|-----|-----|----|----|-----|--------|-----|-----|-----|-----|----|----|-----|--------|-----|-----|-----|-----|----|----|-----|--------|-----|-----|-----|-----|----|-----|-----|--------|-----|-----|---|-----|-----|-----|-----|
| <b>References</b>            | MS 2680:2017 –Energy Efficiency and Use of Renewable Energy for Residential Building – Code of Practice   |        |        |        |        |        |               |        |               |        |     |     |     |    |    |    |     |        |     |     |     |    |    |    |     |        |     |     |     |     |    |    |     |        |     |     |     |     |    |    |     |        |     |     |     |     |    |    |     |        |     |     |     |     |    |     |     |        |     |     |   |     |     |     |     |
| <b>Worked Example 1-3(a)</b> | <p>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:</p> <p style="text-align: center;"><b>Table 1-3.2: Daylight factor for each of the room in every type of layout</b></p> <table border="1" data-bbox="359 1265 1396 1594"> <thead> <tr> <th></th> <th>Room 1</th> <th>Room 2</th> <th>Room 3</th> <th>Room 4</th> <th>Room 5</th> <th>Family</th> <th>Living/Dining</th> </tr> </thead> <tbody> <tr> <td>Type A</td> <td>3.9</td> <td>4.1</td> <td>2.1</td> <td>NA</td> <td>NA</td> <td>NA</td> <td>2.8</td> </tr> <tr> <td>Type B</td> <td>3.9</td> <td>4.1</td> <td>2.1</td> <td>NA</td> <td>NA</td> <td>NA</td> <td>2.8</td> </tr> <tr> <td>Type C</td> <td>3.3</td> <td>2.5</td> <td>2.3</td> <td>1.9</td> <td>NA</td> <td>NA</td> <td>3.8</td> </tr> <tr> <td>Type D</td> <td>3.3</td> <td>2.5</td> <td>2.3</td> <td>1.9</td> <td>NA</td> <td>NA</td> <td>3.8</td> </tr> <tr> <td>Type E</td> <td>3.3</td> <td>2.5</td> <td>2.3</td> <td>1.9</td> <td>NA</td> <td>NA</td> <td>3.8</td> </tr> <tr> <td>Type F</td> <td>4.5</td> <td>1.1</td> <td>2.6</td> <td>2.3</td> <td>NA</td> <td>1.7</td> <td>4.0</td> </tr> <tr> <td>Type G</td> <td>3.3</td> <td>3.5</td> <td>3</td> <td>2.5</td> <td>2.1</td> <td>1.6</td> <td>4.7</td> </tr> </tbody> </table> <p>Total no. of habitable rooms calculated based on each type of units = 36</p> <p>Total no. of habitable rooms with DF ≥ 2.0% = 30</p> <p>Total % of habitable rooms with DF ≥ 2.0% = 30/36 x 100 = 83.3%</p> <p>Credits scored for 1-3(a) = 2 credits</p> |        | 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 |
|                              | 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           |        |               |        |     |     |     |    |    |    |     |        |     |     |     |    |    |    |     |        |     |     |     |     |    |    |     |        |     |     |     |     |    |    |     |        |     |     |     |     |    |    |     |        |     |     |     |     |    |     |     |        |     |     |   |     |     |     |     |

**Worked  
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) (iii) | Day lighting for carparks. | 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**

| <b>Objectives</b>            | Encourage the use of energy efficient lighting to minimise energy consumption from lighting usage  |               |   |        |   |           |   |           |   |         |   |         |   |                           |   |
|------------------------------|--|---------------|---|--------|---|-----------|---|-----------|---|---------|---|---------|---|---------------------------|---|
| <b>Applicability</b>         | <p>Applicable to lighting provisions that designed in accordance to the luminance level as recommended in MS 1525:2019.</p> <p>Use of suitable and effective light fitting such as LED, T5 and etc can contribute to better energy efficiency in buildings.</p>  |               |   |        |   |           |   |           |   |         |   |         |   |                           |   |
| <b>Baseline Standard</b>     | Luminance level stated in MS 1525:2019 –Energy Efficiency and Use of Renewable Energy for Non-Residential Building – Code of Practice  |               |   |        |   |           |   |           |   |         |   |         |   |                           |   |
| <b>Requirements</b>          | <p>Up to 8 credits can be scored for the improvement in the lighting power budget in common areas.</p> <p>0.2 credit for every percentage improvement in the lighting power budget over the baseline standard. That is:</p> <p>Credits scored = 0.2 x (% improvement)</p> <p>Please refer to Table 15 in MS 1525:2019 for maximum lighting power budget (intensity) according to type of usage. Below are some examples:</p> <p style="text-align: center;"><b>Table 1-4.1: Lighting power budget</b></p> <table border="1" data-bbox="448 1111 1326 1402"> <thead> <tr> <th>Type of usage</th> <th>Maximum Lighting Power Budget (W/m<sup>2</sup>)</th> </tr> </thead> <tbody> <tr> <td>Stairs</td> <td>5</td> </tr> <tr> <td>Car parks</td> <td>5</td> </tr> <tr> <td>Corridors</td> <td>5</td> </tr> <tr> <td>Lobbies</td> <td>5</td> </tr> <tr> <td>Toilets</td> <td>6</td> </tr> <tr> <td>Gymnasium (Exercise area)</td> <td>5</td> </tr> </tbody> </table> <p>Remarks:</p> <ol style="list-style-type: none"> <li>1. Display lighting, specialised lighting and building's exterior lighting are to be included in the calculation of lighting power budget.</li> <li>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 and car parks within the residential building.</li> </ol> | Type of usage | Maximum Lighting Power Budget (W/m <sup>2</sup> ) | Stairs | 5 | Car parks | 5 | Corridors | 5 | Lobbies | 5 | Toilets | 6 | Gymnasium (Exercise area) | 5 |
| Type of usage                | Maximum Lighting Power Budget (W/m <sup>2</sup> )  |               |   |        |   |           |   |           |   |         |   |         |   |                           |   |
| Stairs                       | 5  |               |   |        |   |           |   |           |   |         |   |         |   |                           |   |
| Car parks                    | 5  |               |   |        |   |           |   |           |   |         |   |         |   |                           |   |
| Corridors                    | 5  |               |   |        |   |           |   |           |   |         |   |         |   |                           |   |
| Lobbies                      | 5  |               |   |        |   |           |   |           |   |         |   |         |   |                           |   |
| Toilets                      | 6  |               |   |        |   |           |   |           |   |         |   |         |   |                           |   |
| Gymnasium (Exercise area)    | 5  |               |   |        |   |           |   |           |   |         |   |         |   |                           |   |
| <b>Documentary Evidences</b> | <ul style="list-style-type: none"> <li>• Lighting layout plan.</li> <li>• Lighting schedules showing the numbers, locations and types of luminaries used.</li> <li>• Calculation of the proposed lighting power budget and the percentage, improvement in the prescribed tabulated format.</li> <li>• Technical product information of the lighting luminaries used.</li> </ul>  |               |   |        |   |           |   |           |   |         |   |         |   |                           |   |

|                   |   |
|-------------------|---|
| <b>References</b> | MS 1525:2019 –Energy Efficiency and Use of Renewable Energy for Non-Residential Building – Code of Practice |
|-------------------|---|

- Worked Example 1-4**
- Determine the total power consumption based on the lighting layout design for each areas and light fitting types used
  - Calculate the total power consumption based on the maximum lighting power budget stated in MS 1525:2019.
  - Calculate the percentage improvement in the total power consumption.

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

| Description       | Areas (m <sup>2</sup> )<br>(A) | Light Fitting Type<br>(B) | Power Consumption per fitting (W)<br>(C) | Ballast Loss (W)<br>(D) | No. of Fitting<br>(E) | Total power consumption based on fitting type [(C+D)xI] |
|-------------------|--------------------------------|---------------------------|--|-------------------------|-----------------------|---|
| 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 1-4.3: Total power consumption based on design and MS 1525 requirements**

| Description       | Areas (m <sup>2</sup> )<br>(A) | Design Data                                  |   | MS 1525:2019 Requirements                                  |   |
|-------------------|--------------------------------|--|---|--|---|
|                   |                                | Total Power Consumption (by area) (W)<br>(F) | Design Lighting Power Budget (W/m <sup>2</sup> )<br>(F/A) | Reference Lighting Power Budget (W/m <sup>2</sup> )<br>(H) | Reference Total Power Consumption (by area)(W)<br>(HxA) |
| 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   |

% improvement in the lighting power budget

$$= \left[ \frac{\sum (H \times A) - \sum (F)}{\sum (H \times A)} \times 100 \right]$$

$$= \frac{(13100 - 8010)}{13100} \times 100$$

$$= 38.85\%$$

$$\text{Credits scored} = 0.2 \times 38.85\% = 7.8 \text{ (capped at 8 credits)}$$

Therefore, credit scored for 1-4 should be **7.8 credits**.

## RES 1-5 VENTILATION IN CARPARKS

|                              |   |
|------------------------------|---|
| <b>Objectives</b>            | Encourage the use of energy efficient design and control of ventilation systems in car parks.   |
| <b>Applicability</b>         | Applicable to all car park spaces in the development.   |
| <b>Baseline Standard</b>     | -   |
| <b>Requirements</b>          | <p><u>For Multi-Storey Residential Building Only</u><br/>1-5(a) 6 credits can be scored for car park spaces that are fully naturally ventilated.</p> <p>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; 4 credits for car parks using fume extract system and 3 credits for those with MV with or without supply.</p> <p>Note: Where there is a combination of different ventilation modes adopted for carpark design, the credits scored under this requirement will be prorated accordingly.</p> <p><u>For Landed Homes Only</u><br/>1-5 2 credits can be scored for provision of covered car park space that is fully naturally ventilated.</p>  |
| <b>Documentary Evidences</b> | <p><u>For 1-5(a) and (b)</u></p> <ul style="list-style-type: none"> <li>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.</li> </ul> <p><u>For 1-5 I</u></p> <ul style="list-style-type: none"> <li>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.</li> <li>Plan layout indicating the location of CO sensors and the mode of ventilation adopted for the design.</li> <li>Calculation showing the credits allocation if there is a combination of different ventilation mode adopted for the car park design.</li> <li>Technical product information of CO sensors and mechanical ventilation.</li> </ul> |
| <b>References</b>            | -   |
| <b>Worked Example 1-5</b>    | 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<sup>2</sup>

Areas of basement car park – B2 = 500m<sup>2</sup>

Total areas = 1200m<sup>2</sup>

Credits scored for 1-5 =  $(700/1200) \times 4 + (500/1200) \times 3$   
= 3.58 credits

## RES 1-6 DOMESTIC HOT WATER SYSTEM

|                              |   |
|------------------------------|---|
| <b>Objectives</b>            | Encourage the use of innovative hot water heating system to reduce energy bills.  |
| <b>Applicability</b>         | Applicable to all domestic hot water systems in all dwelling units.   |
| <b>Baseline Standard</b>     | -   |
| <b>Requirements</b>          | 2 credits can be scored for installation of gas water heaters or energy efficient heat pump water heaters.<br><br>3 credits can be scored for the use of solar water heaters.   |
| <b>Documentary Evidences</b> | <ul style="list-style-type: none"> <li>• Schematic drawings showing the hot water heating system.</li> <li>• Technical information of the hot water heating system showing the calculation of solar fraction or solar energy factor for solar water heater.</li> <li>• 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.</li> <li>• Sizing calculation for hot water tank.</li> </ul> |
| <b>References</b>            | -   |
| <b>Worked Example 1-6</b>    | <p>Proposed development has the following provision;</p> <p>Solar water heater system serving all hot water needs of dwelling.</p> <p>Therefore, credits scored for 1-6 = 3 credits</p>   |

## RES 1-7 LIFTS

|                              |  |
|------------------------------|--|
| <b>Objectives</b>            | Encourage the use of energy efficient lifts.   |
| <b>Applicability</b>         | Applicable to <b><u>ALL</u></b> lift in the development.   |
| <b>Baseline Standard</b>     | -  |
| <b>Requirements</b>          | 1 credit can be scored for the use of lift with energy efficient features such as AC variable voltage and variable frequency (VVVF) motor drive and energy efficient features such as sleep mode.  |
| <b>Documentary Evidences</b> | <ul style="list-style-type: none"><li>• Extracts of the tender specification indicating the types of lifts and related features used.</li><li>• Schedules showing the total number of lifts and its power consumption.</li><li>• Technical information of the lifts.</li></ul> |
| <b>References</b>            | -  |
| <b>Worked Example 1-6</b>    | <p>Proposed development has the following provision;</p> <p>All lifts are VVVF motor drive with sleep mode features</p> <p>1 credit for the use VVVF motor drive with sleep mode features.</p> <p>Therefore, credits scored for 1-6 = 1 credit</p>                             |

## **RES 1-8 COOL HARDSCAPED AREAS**

|                              |   |
|------------------------------|---|
| <b>Objectives</b>            | Encourage the use of higher SRI materials for non-roof hardscaped areas.  |
| <b>Applicability</b>         | Applicable to all non-roof hardscaped areas in the development.   |
| <b>Baseline Standard</b>     | -   |
| <b>Requirements</b>          | <p>1 credit can be scored if <math>\geq 50\%</math> of non-roof hardscaped areas are finished with materials or finishes with a Solar Reflective Index (SRI) value of 29 or more.</p> <p>2 credits can be scored if <math>\geq 75\%</math> of non-roof hardscaped areas are finished with materials or finishes with a Solar Reflective Index (SRI) value of 29 or more.</p> <p>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:</p> <p>Site area – Plinth Area – Soft scape area = Hardscape area</p> |
| <b>Documentary Evidences</b> | <ul style="list-style-type: none"> <li>• Layout plans showing the composition of the hardscaped area.</li> <li>• Technical specifications showing SRI value of hardscaped area.</li> </ul>  |
| <b>References</b>            | -   |
| <b>Worked Example 1-8</b>    | <p>Proposed development has the following provision;</p> <p><math>\geq 75\%</math> of all non-roof hardscaped area have material with SRI of 29 or more.</p> <p>Therefore, credits scored for 1-8 = 2 credits</p>   |

## **RES 1-9 ENERGY EFFICIENT FEATURES**

|                          |  |
|--------------------------|--|
| <b>Objectives</b>        | Encourage the use of energy efficient features that are innovative and have positive environmental impact in term of energy saving.  |
| <b>Applicability</b>     | Applicable to practices and features that are not listed in the requirements under Part 1 – Energy Efficiency.   |
| <b>Baseline Standard</b> | -  |
| <b>Requirements</b>      | <p>(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)</p> <p>(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.</p> <ol style="list-style-type: none"> <li>i. Use of thermal insulation on the east and west facing external walls <ul style="list-style-type: none"> <li>• 2 credits for window to wall ratio (WWR) of less than 0.5</li> <li>• 1 credit for WWR that is between 0.5 – 0.75</li> <li>• 0.5 credit for WWR of more than 0.75</li> </ul> </li> <li>ii. Use of occupancy sensors for private lift lobbies, staircases, common toilets <ul style="list-style-type: none"> <li>• 1 credit for at least 50 occupancy sensors installed</li> <li>• 0.5 credit for less than 50 occupancy sensors installed</li> </ul> </li> <li>iii. Provision of vertical greenery system on building façades abutting the living, dining and bedrooms areas of dwelling units and club house <ul style="list-style-type: none"> <li>• 2 credits for more than 50% of building façades</li> <li>• 1 credit for at least 25% of building façades</li> <li>• 0.5 credit for clubhouse</li> </ul> </li> <li>iv. Provision of clothes drying facilities and open spaces <ul style="list-style-type: none"> <li>• 1 credit for more than 90% of all dwelling units</li> <li>• 0.5 credit for between 50% to 90% of dwelling units</li> </ul> </li> <li>v. Provision of lifts with better energy efficient features (Up to 2credits) <ul style="list-style-type: none"> <li>• 1 credit for the use of regenerative drive system for at least 90% of lifts installed</li> <li>• 1 credit for the use of gearless drive system for at least 90% of lifts installed</li> </ul> </li> <li>vi. 0.5 credit for the provision of ductless fans for basement ventilation.</li> <li>vii. 0.5 credit for the computation of EEI for common facilities of the development.</li> </ol> |

**Calculation of EEI for Common Facilities:**

EEI : 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, carpark, landscape, façade lighting, guardhouse ant etc.*

*Total area for common area = Area of common area/ facilities in the building (not inclusive of the outdoor landscape are and carpark)*

The common facilities and the daily usage hours of these facilities are pre-determined for consistency as shown in Table 1-7.1. They are to be used in the computation for EEI. 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.

**Table 1-7.1: Common Facilities and Daily Usage Pattern**

| Description   | Daily Usage (hr) |
|---|------------------|
| <b>A) Mechanical Load</b>   |                  |
| 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>B) Lift Load</b>   |                  |
| Passenger lifts   | 2                |
| Service lift  | 2                |
| <b>C) General lighting</b>  |                  |
| Car park lighting – 24 hours operation                            | 24               |
| Car park lighting – 5 hours operation                             | 5                |
| 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                |
| <b>D) Club Facilities</b>   |                  |
| Club house interior lighting                                      | 12               |
| Power to Gym equipment, SPA, etc                                  | 6                |
| Swimming pool filtration  | 12               |
| Water features  | 8                |
| <b>E) Others</b>  |                  |
| Facilities A  | To estimate      |
| Facilities B  | To estimate      |

**Notes:** For features that are not listed in RES 1-7 (i) to (vii) 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

| <b>Documentary Evidences</b>                                     | <ul style="list-style-type: none"> <li>• Extracts of the tender specification showing the provision of the proposed energy efficient features and the extent of implementation where applicable.</li> <li>• Technical product information on the energy efficient features used.</li> <li>• Calculation of the potential energy saving that could be reaped from the use of these features.</li> <li>• Calculation of the Energy Efficiency Index (EEI) using the pre-determined daily usage pattern and in the prescribed tabulated format.</li> <li>• Detail calculation including operation hours for the estimated energy load for each component in the building etc.: lighting, air conditioning system, pump, receptacle load.</li> </ul>   |                  |                     |                  |                    |                           |  |  |  |                     |   |   |    |              |     |   |      |                    |   |    |    |  |   |    |   |                     |   |    |    |               |    |   |     |              |    |   |    |              |    |   |    |           |    |     |   |                     |  |  |  |                 |     |   |     |               |   |   |   |                            |  |  |  |  |    |    |     |                                       |    |   |     |                      |     |    |     |                 |   |   |   |   |    |    |     |  |    |   |     |  |    |    |     |   |    |   |    |                           |  |  |  |                              |    |    |     |                               |    |   |     |                          |    |    |     |
|--|--|------------------|---------------------|------------------|--------------------|---------------------------|--|--|--|---------------------|---|---|----|--------------|-----|---|------|--------------------|---|----|----|--|---|----|---|---------------------|---|----|----|---------------|----|---|-----|--------------|----|---|----|--------------|----|---|----|-----------|----|-----|---|---------------------|--|--|--|-----------------|-----|---|-----|---------------|---|---|---|----------------------------|--|--|--|--|----|----|-----|---------------------------------------|----|---|-----|----------------------|-----|----|-----|-----------------|---|---|---|---|----|----|-----|--|----|---|-----|--|----|----|-----|---|----|---|----|---------------------------|--|--|--|------------------------------|----|----|-----|-------------------------------|----|---|-----|--------------------------|----|----|-----|
| <b>References</b>  | -  |                  |                     |                  |                    |                           |  |  |  |                     |   |   |    |              |     |   |      |                    |   |    |    |  |   |    |   |                     |   |    |    |               |    |   |     |              |    |   |    |              |    |   |    |           |    |     |   |                     |  |  |  |                 |     |   |     |               |   |   |   |                            |  |  |  |  |    |    |     |                                       |    |   |     |                      |     |    |     |                 |   |   |   |   |    |    |     |  |    |   |     |  |    |    |     |   |    |   |    |                           |  |  |  |                              |    |    |     |                               |    |   |     |                          |    |    |     |
| <b>Worked Example 1-7(vii)</b>                                   | <p><u>Background info:</u><br/>Proposed residential development with the following estimated electricity consumption for common facilities.</p> <p style="text-align: center;"><b>Table 1-7.2: Estimated electricity consumption for common facilities</b></p> <table border="1" data-bbox="360 801 1398 2027"> <thead> <tr> <th>Description</th> <th>Estimated Load (KW)</th> <th>Daily usage (hr)</th> <th>Load per day (KWh)</th> </tr> </thead> <tbody> <tr> <td colspan="4"><b>A) Mechanical Load</b></td> </tr> <tr> <td>MV fan (plant room)</td> <td>9</td> <td>9</td> <td>81</td> </tr> <tr> <td>Car park fan</td> <td>320</td> <td>4</td> <td>1280</td> </tr> <tr> <td>A/C for club house</td> <td>8</td> <td>12</td> <td>96</td> </tr> <tr> <td>A/C for lobbies (1<sup>st</sup>sty &amp; Basement)</td> <td>0</td> <td>12</td> <td>0</td> </tr> <tr> <td>A/C for guard house</td> <td>2</td> <td>24</td> <td>48</td> </tr> <tr> <td>Domestic pump</td> <td>70</td> <td>2</td> <td>140</td> </tr> <tr> <td>Ejector pump</td> <td>13</td> <td>2</td> <td>26</td> </tr> <tr> <td>Booster pump</td> <td>28</td> <td>3</td> <td>84</td> </tr> <tr> <td>Sump pump</td> <td>12</td> <td>0.5</td> <td>6</td> </tr> <tr> <td colspan="4"><b>B) Lift Load</b></td> </tr> <tr> <td>Passenger Lifts</td> <td>470</td> <td>2</td> <td>940</td> </tr> <tr> <td>Service lifts</td> <td>0</td> <td>2</td> <td>0</td> </tr> <tr> <td colspan="4"><b>C) General lighting</b></td> </tr> <tr> <td>Car park lighting – 24 hours operation</td> <td>23</td> <td>24</td> <td>552</td> </tr> <tr> <td>Car park lighting – 5 hours operation</td> <td>23</td> <td>5</td> <td>115</td> </tr> <tr> <td>Guard house lighting</td> <td>0.3</td> <td>12</td> <td>3.6</td> </tr> <tr> <td>Façade lighting</td> <td>0</td> <td>5</td> <td>0</td> </tr> <tr> <td>Landscape lighting – 12 hours operation</td> <td>30</td> <td>12</td> <td>360</td> </tr> <tr> <td>Landscape lighting – 5 hours operation</td> <td>28</td> <td>5</td> <td>140</td> </tr> <tr> <td>Lift lobbies, corridor &amp; staircase Lighting – 12 hours operation</td> <td>20</td> <td>12</td> <td>240</td> </tr> <tr> <td>Lift lobbies, corridor &amp; staircase Lighting – 5 hours operation</td> <td>19</td> <td>5</td> <td>95</td> </tr> <tr> <td colspan="4"><b>D) Club Facilities</b></td> </tr> <tr> <td>Club house interior lighting</td> <td>12</td> <td>12</td> <td>144</td> </tr> <tr> <td>Power Gym equipment, SPA, etc</td> <td>85</td> <td>6</td> <td>510</td> </tr> <tr> <td>Swimming Pool Filtration</td> <td>50</td> <td>12</td> <td>600</td> </tr> </tbody> </table> | Description      | Estimated Load (KW) | Daily usage (hr) | Load per day (KWh) | <b>A) Mechanical Load</b> |  |  |  | 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 (1 <sup>st</sup> sty & 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>B) Lift Load</b> |  |  |  | Passenger Lifts | 470 | 2 | 940 | Service lifts | 0 | 2 | 0 | <b>C) General lighting</b> |  |  |  | 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, corridor & staircase Lighting – 12 hours operation | 20 | 12 | 240 | Lift lobbies, corridor & staircase Lighting – 5 hours operation | 19 | 5 | 95 | <b>D) Club Facilities</b> |  |  |  | Club house interior lighting | 12 | 12 | 144 | Power Gym equipment, SPA, etc | 85 | 6 | 510 | Swimming Pool Filtration | 50 | 12 | 600 |
| Description  | Estimated Load (KW)  | Daily usage (hr) | Load per day (KWh)  |                  |                    |                           |  |  |  |                     |   |   |    |              |     |   |      |                    |   |    |    |  |   |    |   |                     |   |    |    |               |    |   |     |              |    |   |    |              |    |   |    |           |    |     |   |                     |  |  |  |                 |     |   |     |               |   |   |   |                            |  |  |  |  |    |    |     |                                       |    |   |     |                      |     |    |     |                 |   |   |   |   |    |    |     |  |    |   |     |  |    |    |     |   |    |   |    |                           |  |  |  |                              |    |    |     |                               |    |   |     |                          |    |    |     |
| <b>A) Mechanical Load</b>  |  |                  |                     |                  |                    |                           |  |  |  |                     |   |   |    |              |     |   |      |                    |   |    |    |  |   |    |   |                     |   |    |    |               |    |   |     |              |    |   |    |              |    |   |    |           |    |     |   |                     |  |  |  |                 |     |   |     |               |   |   |   |                            |  |  |  |  |    |    |     |                                       |    |   |     |                      |     |    |     |                 |   |   |   |   |    |    |     |  |    |   |     |  |    |    |     |   |    |   |    |                           |  |  |  |                              |    |    |     |                               |    |   |     |                          |    |    |     |
| 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 (1 <sup>st</sup> sty & 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>B) Lift Load</b>  |  |                  |                     |                  |                    |                           |  |  |  |                     |   |   |    |              |     |   |      |                    |   |    |    |  |   |    |   |                     |   |    |    |               |    |   |     |              |    |   |    |              |    |   |    |           |    |     |   |                     |  |  |  |                 |     |   |     |               |   |   |   |                            |  |  |  |  |    |    |     |                                       |    |   |     |                      |     |    |     |                 |   |   |   |   |    |    |     |  |    |   |     |  |    |    |     |   |    |   |    |                           |  |  |  |                              |    |    |     |                               |    |   |     |                          |    |    |     |
| Passenger Lifts  | 470  | 2                | 940                 |                  |                    |                           |  |  |  |                     |   |   |    |              |     |   |      |                    |   |    |    |  |   |    |   |                     |   |    |    |               |    |   |     |              |    |   |    |              |    |   |    |           |    |     |   |                     |  |  |  |                 |     |   |     |               |   |   |   |                            |  |  |  |  |    |    |     |                                       |    |   |     |                      |     |    |     |                 |   |   |   |   |    |    |     |  |    |   |     |  |    |    |     |   |    |   |    |                           |  |  |  |                              |    |    |     |                               |    |   |     |                          |    |    |     |
| Service lifts  | 0  | 2                | 0                   |                  |                    |                           |  |  |  |                     |   |   |    |              |     |   |      |                    |   |    |    |  |   |    |   |                     |   |    |    |               |    |   |     |              |    |   |    |              |    |   |    |           |    |     |   |                     |  |  |  |                 |     |   |     |               |   |   |   |                            |  |  |  |  |    |    |     |                                       |    |   |     |                      |     |    |     |                 |   |   |   |   |    |    |     |  |    |   |     |  |    |    |     |   |    |   |    |                           |  |  |  |                              |    |    |     |                               |    |   |     |                          |    |    |     |
| <b>C) General lighting</b>                                       |  |                  |                     |                  |                    |                           |  |  |  |                     |   |   |    |              |     |   |      |                    |   |    |    |  |   |    |   |                     |   |    |    |               |    |   |     |              |    |   |    |              |    |   |    |           |    |     |   |                     |  |  |  |                 |     |   |     |               |   |   |   |                            |  |  |  |  |    |    |     |                                       |    |   |     |                      |     |    |     |                 |   |   |   |   |    |    |     |  |    |   |     |  |    |    |     |   |    |   |    |                           |  |  |  |                              |    |    |     |                               |    |   |     |                          |    |    |     |
| 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, corridor & staircase Lighting – 12 hours operation | 20   | 12               | 240                 |                  |                    |                           |  |  |  |                     |   |   |    |              |     |   |      |                    |   |    |    |  |   |    |   |                     |   |    |    |               |    |   |     |              |    |   |    |              |    |   |    |           |    |     |   |                     |  |  |  |                 |     |   |     |               |   |   |   |                            |  |  |  |  |    |    |     |                                       |    |   |     |                      |     |    |     |                 |   |   |   |   |    |    |     |  |    |   |     |  |    |    |     |   |    |   |    |                           |  |  |  |                              |    |    |     |                               |    |   |     |                          |    |    |     |
| Lift lobbies, corridor & staircase Lighting – 5 hours operation  | 19   | 5                | 95                  |                  |                    |                           |  |  |  |                     |   |   |    |              |     |   |      |                    |   |    |    |  |   |    |   |                     |   |    |    |               |    |   |     |              |    |   |    |              |    |   |    |           |    |     |   |                     |  |  |  |                 |     |   |     |               |   |   |   |                            |  |  |  |  |    |    |     |                                       |    |   |     |                      |     |    |     |                 |   |   |   |   |    |    |     |  |    |   |     |  |    |    |     |   |    |   |    |                           |  |  |  |                              |    |    |     |                               |    |   |     |                          |    |    |     |
| <b>D) Club Facilities</b>  |  |                  |                     |                  |                    |                           |  |  |  |                     |   |   |    |              |     |   |      |                    |   |    |    |  |   |    |   |                     |   |    |    |               |    |   |     |              |    |   |    |              |    |   |    |           |    |     |   |                     |  |  |  |                 |     |   |     |               |   |   |   |                            |  |  |  |  |    |    |     |                                       |    |   |     |                      |     |    |     |                 |   |   |   |   |    |    |     |  |    |   |     |  |    |    |     |   |    |   |    |                           |  |  |  |                              |    |    |     |                               |    |   |     |                          |    |    |     |
| Club house interior lighting                                     | 12   | 12               | 144                 |                  |                    |                           |  |  |  |                     |   |   |    |              |     |   |      |                    |   |    |    |  |   |    |   |                     |   |    |    |               |    |   |     |              |    |   |    |              |    |   |    |           |    |     |   |                     |  |  |  |                 |     |   |     |               |   |   |   |                            |  |  |  |  |    |    |     |                                       |    |   |     |                      |     |    |     |                 |   |   |   |   |    |    |     |  |    |   |     |  |    |    |     |   |    |   |    |                           |  |  |  |                              |    |    |     |                               |    |   |     |                          |    |    |     |
| Power Gym equipment, SPA, etc                                    | 85   | 6                | 510                 |                  |                    |                           |  |  |  |                     |   |   |    |              |     |   |      |                    |   |    |    |  |   |    |   |                     |   |    |    |               |    |   |     |              |    |   |    |              |    |   |    |           |    |     |   |                     |  |  |  |                 |     |   |     |               |   |   |   |                            |  |  |  |  |    |    |     |                                       |    |   |     |                      |     |    |     |                 |   |   |   |   |    |    |     |  |    |   |     |  |    |    |     |   |    |   |    |                           |  |  |  |                              |    |    |     |                               |    |   |     |                          |    |    |     |
| Swimming Pool Filtration   | 50   | 12               | 600                 |                  |                    |                           |  |  |  |                     |   |   |    |              |     |   |      |                    |   |    |    |  |   |    |   |                     |   |    |    |               |    |   |     |              |    |   |    |              |    |   |    |           |    |     |   |                     |  |  |  |                 |     |   |     |               |   |   |   |                            |  |  |  |  |    |    |     |                                       |    |   |     |                      |     |    |     |                 |   |   |   |   |    |    |     |  |    |   |     |  |    |    |     |   |    |   |    |                           |  |  |  |                              |    |    |     |                               |    |   |     |                          |    |    |     |

|  |   |                |   |     |
|--|---|----------------|---|-----|
|  | Water Feature   | 25             | 8 | 200 |
|  | <b>Total KWh per day</b>  | <b>5660.60</b> |   |     |
|  | <p><b><u>Calculation of EEI for common facilities:</u></b><br/> Total consumption per day = 5,660.60 kWh/day<br/> EEI = (TEC/GFA) x 365 days<br/> = (5,660.60/40,000) x 365<br/> = 51.65 kWh/m<sup>2</sup>/year</p> |                |   |     |
|  |   |                |   |     |

## RES 1-10 RENEWABLE ENERGY

|                              |  |
|------------------------------|--|
| <b>Objectives</b>            | Encourage the use of renewable energy sources in buildings.  |
| <b>Applicability</b>         | Includes all renewable energy sources  |
| <b>Baseline Standard</b>     | -  |
| <b>Requirements</b>          | <p>Up to 16 credits can be scored based on the percentage replacement of electricity by the renewable energy source</p> <p><u>For Multi-Storey Residential</u><br/>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.</p> <p><u>For Landed Homes</u><br/>3 credits for every 5% replacement of electricity by renewable energy (per house unit)</p> <p>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).</p> |
| <b>Documentary Evidences</b> | <ul style="list-style-type: none"> <li>• Extract of the tender specification and plans showing the location of the renewable energy system and the extent of implementation.</li> <li>• Technical product information on the salient features of the renewable energy system and the expected renewable energy generated.</li> <li>• Plan layout of location for installation of renewable energy system, total kWp and predicted annual generation kWh.</li> <li>• Calculation of the percentage replacement of electricity and the total annual electricity consumption of the development.</li> </ul>   |
| <b>References</b>            | -  |
| <b>Worked Example 1-8</b>    | <p>A residential development with GFA of 15,000m<sup>2</sup>.</p> <p>The Energy Efficiency Index for its common facilities is 50 kWh/m<sup>2</sup>/year</p> <p>The installation of solar array on the roof of its open car park was estimated to generate 7,500 kWh annually</p> <p>Total electricity consumption of the development's common areas<br/>= 50 x 15,000 = 750, 000 kWh/year</p> <p>Percentage of replacement of electricity by renewable energy<br/>= 7,500 / 750,000 x 100%<br/>= 1%</p> <p>Credits scored for 1-8 for 1% replacement of electricity = 3 credits</p>  |

## (II) Other Green Requirements

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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**

| <b>Objectives</b>  | 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).   |  |  |  |             |                     |                    |                   |                 |                  |
|--|--|--|--|--|-------------|---------------------|--------------------|-------------------|-----------------|------------------|
| <b>Applicability</b>   | Applicable to the water fittings covered by the WEPLS or WELS as follows: <ul style="list-style-type: none"> <li>• Basin taps and mixers</li> <li>• Flushing cistern</li> <li>• Sink/bib taps and mixers</li> <li>• Shower taps and mixers or showerheads</li> <li>• Urinals and urinals flush valve</li> <li>• Showerheads</li> </ul>   |  |  |  |             |                     |                    |                   |                 |                  |
| <b>Baseline Standard</b>   | As specified under Water Efficiency Product Labelling Scheme (WEPLS) or Water Efficiency Labelling Scheme (WELS).  |  |  |  |             |                     |                    |                   |                 |                  |
| <b>Requirements</b>  | 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). <table border="1" data-bbox="363 891 1401 1055"> <thead> <tr> <th colspan="3">Rating Based on Water Efficiency Products Labelling Scheme (WEPLS)</th> </tr> <tr> <th>Efficient *</th> <th>Highly Efficient **</th> <th>Most Efficient ***</th> </tr> </thead> <tbody> <tr> <td><b>0.5 credit</b></td> <td><b>1 credit</b></td> <td><b>2 credits</b></td> </tr> </tbody> </table> <p><i>Note: At least 90% of each fitting type must be rated to be able to score for the credits</i></p>  | Rating Based on Water Efficiency Products Labelling Scheme (WEPLS) |  |  | Efficient * | Highly Efficient ** | Most Efficient *** | <b>0.5 credit</b> | <b>1 credit</b> | <b>2 credits</b> |
| Rating Based on Water Efficiency Products Labelling Scheme (WEPLS) |  |  |  |  |             |                     |                    |                   |                 |                  |
| Efficient *  | Highly Efficient **  | Most Efficient ***   |  |  |             |                     |                    |                   |                 |                  |
| <b>0.5 credit</b>  | <b>1 credit</b>  | <b>2 credits</b>   |  |  |             |                     |                    |                   |                 |                  |
| <b>Documentary Evidences</b>                                       | <ul style="list-style-type: none"> <li>• Extracts of the tender specification showing all the water fitting provisions for the development.</li> <li>• 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.</li> <li>• Schematic drawing of cold water and sanitary plumbing.</li> <li>• Calculation showing the percentage of proposed water fittings that are approved under any international recognized water efficiency labelling scheme e.g. WEPLS or WELS.</li> <li>• 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.</li> </ul> |  |  |  |             |                     |                    |                   |                 |                  |
| <b>References</b>  | <ol style="list-style-type: none"> <li>1. For more information on WEPLS, please refer to:<br/><a href="http://www.span.gov.my/index.php?option=com_content&amp;view">http://www.span.gov.my/index.php?option=com_content&amp;view</a></li> <li>2. For more information of WELS, please refer to:<br/><a href="http://www.pub.gov.sg/wels/Pages/default.aspx">http://www.pub.gov.sg/wels/Pages/default.aspx</a></li> </ol>  |  |  |  |             |                     |                    |                   |                 |                  |

**Worked 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).

**Table 2-1.1: Computation of credits for water fittings**

| Ref   | Water Fitting Type              | WEPLS rating |                  |                |           | Total | Percentage of rated fitting (%) | 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                 |

Credits scored = 5 credits

## **RES 2-2 WATER USAGE MONITORING**

|                              |  |
|------------------------------|--|
| <b>Objectives</b>            | Promote the use of sub meters for better control and monitoring of major water usage.  |
| <b>Applicability</b>         | Applicable to sub-metering provisions for major water uses of the building developments.   |
| <b>Baseline Standard</b>     | -  |
| <b>Requirements</b>          | 1 credit can be scored if sub meters are provided for <b><u>ALL</u></b> major water uses i.e. irrigation system, cooling tower and tenant's usage.   |
| <b>Documentary Evidences</b> | <ul style="list-style-type: none"><li>• Extracts from the tender specification stating the locations and provision of private meters for all major water uses.</li><li>• Schematic drawings of cold-water distribution system showing the location of the sub meters provided.</li></ul> |
| <b>References</b>            | -  |

## RES 2-3 IRRIGATION SYSTEM AND LANDSCAPING

|                             |  |
|-----------------------------|--|
| <b>Objectives</b>           | Reduce potable water consumption by provision of suitable systems that utilizes rainwater or recycled water for landscape irrigation and use of plants that require minimal irrigation to reduce potable water consumption.  |
| <b>Applicability</b>        | Applicable to residential development with landscaping provision.  |
| <b>Baseline Standard</b>    | -  |
| <b>Requirements</b>         | <p>2-3(a) 1 credit can be scored for the use of non-potable water including rainwater for landscape irrigation.</p> <p>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.</p> <p>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.</p>   |
| <b>Documentary Evidence</b> | <p><u>For 2-3(a)</u></p> <ul style="list-style-type: none"> <li>• Extracts of the tender specification showing how the non-potable water source is to provided.</li> <li>• Relevant drawings showing the location and design of non-potable water source.</li> <li>• Calculation showing the percentage of potable water saved for irrigation system.</li> </ul> <p><u>For 2-3(b)</u></p> <ul style="list-style-type: none"> <li>• Extracts of the tender specification showing the provision and details of water efficient irrigation system;</li> <li>• Relevant layout plans showing the overall landscape areas and the areas that would be served using the system; and</li> <li>• Calculation showing the percentage of the landscape areas that would be served using the system.</li> <li>• Product technical information of the irrigation system.</li> </ul> <p><u>For 2-3(c)</u></p> <ul style="list-style-type: none"> <li>• Relevant layout plans showing the overall landscape areas and the areas that use drought tolerant plants or plants that require minimal irrigation.</li> <li>• Calculation showing the percentage of the landscape areas that use drought tolerant plants or plants that require minimal irrigation (at least 80%).</li> <li>• Plant species showing the minimum water requirement.</li> </ul> |
| <b>References</b>           | <ol style="list-style-type: none"> <li>1. Manual Saliran Mesra Alam Malaysia(MSMA) (2000), Ministry of Natural Resources and Environment</li> <li>2. "Rainwater – Guideline for Installing A Rainwater Collection and Utilization System",KPKT (1999)</li> <li>3. "Rainwater Harvesting – Guidebook Planning and Design" Department of Irrigation and Drainage, Ministry of Natural Resources and Environment.</li> <li>4. The list of drought tolerant or resistant plant species may be obtained from</li> </ol>   |

the online website: <http://florafaunaweb.nparks.gov.sg/>

### 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                             |
|          |                |                        |          | <b>44844.5</b>                     |

Irrigation water requirement (Litre/Day) 44844.5

#### Roof Catchment

| Type           | m <sup>2</sup> | 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 <sup>2</sup> ) | 2349   |
| Catchment Area x Run -off coefficient  | 1670.1 |

| Type Of System                         | First Flush System   |
|--|--|
| Equation                               | Collectible Rainwater =<br>Rainfall x Catchment Area x<br>Run Off Coefficient - (Total<br>Catchment Area x First Flush<br>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 (%)            | <b>23.71</b>   |

**Worked Example 3(a)**      2-

(II)

## (III) Other Green Requirements

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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**

## **RES 3-1 SUSTAINABLE CONSTRUCTION**

| <b>Objectives</b>   | Encourage recycling and the adoption of building designs, construction practices and materials that are environmentally friendly and sustainable.  |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
|---|--|---|-------------------|----|---|----|---|----|---|----|---|-----|---|---|--------------------|--------|---|--------|---|-------|---|-------|---|-------|---|
| <b>Applicability</b>                                      | Generally applicable to all building developments.   |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| <b>Baseline Standard</b>                                  | -  |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| <b>Requirements</b>                                       | <p>3-1(a) Up to 5 credits can be scored with the use of sustainable and recycled materials</p> <p>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:</p> <p><b>Table 3-1.1 : Credits allocation according to replacement percentage</b></p> <table border="1"> <thead> <tr> <th>Replacement of OPC by approved industrial by-products (%)</th> <th>Credit Allocation</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>1</td> </tr> <tr> <td>20</td> <td>2</td> </tr> <tr> <td>30</td> <td>3</td> </tr> <tr> <td>40</td> <td>4</td> </tr> <tr> <td>&gt;50</td> <td>5</td> </tr> </tbody> </table> <p>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.</p> <p><b>Table 3-1.2 : Credits allocation for project CUI</b></p> <table border="1"> <thead> <tr> <th>Project CUI (m<sup>3</sup>/m<sup>2</sup>)</th> <th>Credits Allocation</th> </tr> </thead> <tbody> <tr> <td>≤ 0.70</td> <td>1</td> </tr> <tr> <td>≤ 0.60</td> <td>2</td> </tr> <tr> <td>≤0.50</td> <td>3</td> </tr> <tr> <td>≤0.40</td> <td>4</td> </tr> <tr> <td>≤0.35</td> <td>5</td> </tr> </tbody> </table> <p>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. <b>CUI does not include the concrete used for external works and sub-structural works such as basements and foundations.</b> 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 :</p> <p>Concrete Usage Index = <math>\frac{\text{Concrete Volume (m}^3\text{)}}{\text{Constructed Floor Area (m}^2\text{)}}</math></p> | Replacement of OPC by approved industrial by-products (%) | Credit Allocation | 10 | 1 | 20 | 2 | 30 | 3 | 40 | 4 | >50 | 5 | Project CUI (m <sup>3</sup> /m <sup>2</sup> ) | Credits Allocation | ≤ 0.70 | 1 | ≤ 0.60 | 2 | ≤0.50 | 3 | ≤0.40 | 4 | ≤0.35 | 5 |
| Replacement of OPC by approved industrial by-products (%) | Credit Allocation  |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| 10  | 1  |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| 20  | 2  |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| 30  | 3  |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| 40  | 4  |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| >50   | 5  |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| Project CUI (m <sup>3</sup> /m <sup>2</sup> )             | Credits Allocation   |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| ≤ 0.70  | 1  |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| ≤ 0.60  | 2  |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| ≤0.50   | 3  |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| ≤0.40   | 4  |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |
| ≤0.35   | 5  |   |                   |    |   |    |   |    |   |    |   |     |   |   |                    |        |   |        |   |       |   |       |   |       |   |

| <p><b>Documentary Evidences</b></p> | <p><u>For 3-1(a)</u></p> <ul style="list-style-type: none"> <li>• Extract of tender specification showing the requirements to use of Green Cement / Concrete.</li> <li>• Certificate of products showing the recycled content.</li> <li>• Calculation of estimated quantity of replacement by mass of Green Cement / Concrete.</li> </ul> <p><u>For 3-1(b)</u></p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Bill of quantities showing the volume of concrete to be used.</li> <li>• Detail Concrete Usage Index (CUI) calculation showing the quantity of concrete for each floor level.</li> </ul>  |                            |                                |  |                                |  |   |          |         |       |      |   |          |     |    |     |   |          |       |    |      |   |          |       |    |       |  |              |               |  |               |
|-------------------------------------|--|----------------------------|--------------------------------|--|--------------------------------|--|---|----------|---------|-------|------|---|----------|-----|----|-----|---|----------|-------|----|------|---|----------|-------|----|-------|--|--------------|---------------|--|---------------|
| <p><b>Worked Example 3-1(a)</b></p> | <p>Proposed development will used Grade 35, 40, 70 and 80 concrete.</p> <p>From the concrete design mix the percentage of replacement of OPC by the green cements as follow:</p> <p>Grade 35 = 15.52 %<br/> Grade 40 = 63%<br/> Grade 70 = 59 %<br/> Grade 80 = 58 %</p> <table border="1" data-bbox="418 1050 1458 1408"> <thead> <tr> <th>No</th> <th>Concrete Grade</th> <th>Quantity (m<sup>3</sup>)</th> <th>Percentage of Green Cement (%)</th> <th>Green Cement Quantity in (m<sup>3</sup>)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Grade 35</td> <td>27, 381</td> <td>15.52</td> <td>4250</td> </tr> <tr> <td>2</td> <td>Grade 40</td> <td>448</td> <td>63</td> <td>282</td> </tr> <tr> <td>3</td> <td>Grade 70</td> <td>12141</td> <td>59</td> <td>7163</td> </tr> <tr> <td>4</td> <td>Grade 80</td> <td>12155</td> <td>58</td> <td>7,050</td> </tr> <tr> <td></td> <td><b>Total</b></td> <td><b>52,155</b></td> <td></td> <td><b>18,745</b></td> </tr> </tbody> </table> <p>Overall % Green Cement replacement = <math>18,745/52,155 = 35.96\%</math><br/> Hence, achieved <b><u>2 credits</u></b></p> | No                         | Concrete Grade                 | Quantity (m <sup>3</sup> )                 | Percentage of Green Cement (%) | Green Cement Quantity in (m <sup>3</sup> ) | 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 |  | <b>Total</b> | <b>52,155</b> |  | <b>18,745</b> |
| No                                  | Concrete Grade   | Quantity (m <sup>3</sup> ) | Percentage of Green Cement (%) | Green Cement Quantity in (m <sup>3</sup> ) |                                |  |   |          |         |       |      |   |          |     |    |     |   |          |       |    |      |   |          |       |    |       |  |              |               |  |               |
| 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                                      |                                |  |   |          |         |       |      |   |          |     |    |     |   |          |       |    |      |   |          |       |    |       |  |              |               |  |               |
|                                     | <b>Total</b>   | <b>52,155</b>              |                                | <b>18,745</b>                              |                                |  |   |          |         |       |      |   |          |     |    |     |   |          |       |    |      |   |          |       |    |       |  |              |               |  |               |

**Worked Example 3-1(b)**

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

**Table 3-1.3 : Concrete usage and constructed floor areas**

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

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

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

Based on the calculation shown in Table 3-1.4

$$\text{CUI of } 0.4 \text{ m}^3/\text{m}^2 \leq 0.4 \text{ m}^3/\text{m}^2$$

Therefore, credits scored = 4 credits

Refer to the following Table 3-1.4 for more details

**Worked Example 3-1(b) – Cont'd**

**Table 3-1.4 – Concrete Usage Index**

| COMPUTATION OF CONCRETE USAGE INDEX                                  |                                  | RESIDENTIAL BLDG                               |                       |
|--|----------------------------------|--|-----------------------|
| Project Reference No.: <u>AXXXX-00001-2015</u>                       |                                  | Total no. of storey for the project: <u>15</u> |                       |
| Block No: <u>A</u>   |                                  |  |                       |
| Structural System  | Thickness (mm) or size (mm x mm) | Volume of concrete (m <sup>3</sup> )           | Remark *              |
| <b>1</b>   | <b>1<sup>st</sup> storey</b>     |  |                       |
| 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 <sup>3</sup> )           |                                  | 587  |                       |
| Total constructed floor area for this storey (m <sup>2</sup> )       |                                  | 1000   |                       |
| <b>2</b>   | <b>Typical floor layout</b>      |  |                       |
| 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                    |

**Worked  
Example  
3-1(b)  
Cont'd**

| COMPUTATION OF CONCRETE USAGE INDEX  |  | RESIDENTIAL BLDG                               |          |    |
|--|--|--|----------|----|
| Project Reference No. : <u>AXXXX-00001-2015</u>  |  | Total no. of storey for the project: <u>15</u> |          |    |
| Block No : <u>A</u>  |  |  |          |    |
| Structural System  | Thickness (mm) or size (mm x mm)   | Volume of concrete (m <sup>3</sup> )           | Remark * |    |
| 2  | 2 <sup>nd</sup> storey to 30 <sup>th</sup> 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 <sup>3</sup> )  |  | 360  |          |    |
| Constructed floor area for one storey  |  | 933.3  |          |    |
| Total volume of concrete for 2 <sup>nd</sup> to 15 <sup>th</sup> storey  |  | 360x15=5400                                    |          |    |
| Total constructed floor area for 2 <sup>nd</sup> to 15 <sup>th</sup> storey (m <sup>2</sup> ) (including roof level) |  | 933.3x15=14000                                 |          |    |
| Total volume of concrete for this project (m <sup>3</sup> )  |  | 5987   |          |    |
| Total constructed floor area for this project (m <sup>2</sup> )  |  | 15000  |          |    |
| Concrete Usage Index (CUI in m <sup>3</sup> /m <sup>2</sup> )  |  | 0.4  |          |    |

\*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

| <b>Objectives</b>                                 | Encourage the use of products that are environmentally friendly and sustainable.  |   |                                  |            |     |               |   |             |   |
|---|---|---|----------------------------------|------------|-----|---------------|---|-------------|---|
| <b>Applicability</b>                              | Applicable to non-structural and architectural building components.   |   |                                  |            |     |               |   |             |   |
| <b>Baseline Standard</b>                          | -   |   |                                  |            |     |               |   |             |   |
| <b>Requirements</b>                               | <p>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.</p> <p>The environmentally friendly product proposed must be approved by a valid international or local certification body and is subject to GreenRE's evaluation.</p> <p style="text-align: center;"><b>Table 3-2.1 : Weightage for credits allocation</b></p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="background-color: #cccccc;">Extent of use of environmentally friendly product</th> <th style="background-color: #cccccc;">Weightage for Credits Allocation</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>The use of environmental friendly products or recycled materials used for all dwelling units of the development will be considered as <u>high impact</u> (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).</p> <p>Items that are used for all common areas, external works and communal facilities are considered as <u>medium impact (1 credit)</u> 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)</p> <p>Note:</p> <ol style="list-style-type: none"> <li>(1) 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 <u>low impact</u>. All applications will be subject to GreenRE's evaluation.</li> <li>(2) Same type of the product not allowed to be double claimed for different area application</li> <li>(3) The credit allocated for low volatile organic compound (VOC) paints and adhesives</li> </ol> | Extent of use of environmentally friendly product | Weightage for Credits Allocation | Low impact | 0.5 | Medium Impact | 1 | High Impact | 2 |
| Extent of use of environmentally friendly product | Weightage for Credits Allocation  |   |                                  |            |     |               |   |             |   |
| Low impact  | 0.5   |   |                                  |            |     |               |   |             |   |
| Medium Impact                                     | 1   |   |                                  |            |     |               |   |             |   |
| High Impact                                       | 2   |   |                                  |            |     |               |   |             |   |

|                              |  |
|------------------------------|--|
|                              | 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>Documentary Evidences</b> | <ul style="list-style-type: none"> <li>• 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.</li> <li>• Certification details from approved local/international certification body such as the material certification standards, rating and details.</li> <li>• Technical product information on the sustainable products.</li> <li>• Calculation of products and extent of coverage.</li> </ul>  |
| <b>References</b>            | <p>For more info on product certification, please refer to:</p> <p><a href="http://www.sirim-qas.com.my/index.php/zh/our-services/product-certification/eco-labelling-scheme">http://www.sirim-qas.com.my/index.php/zh/our-services/product-certification/eco-labelling-scheme</a></p> <p><a href="http://www.sec.org.sg/sgls">http://www.sec.org.sg/sgls</a> or <a href="http://www.sgbc.sg/green-certifications">http://www.sgbc.sg/green-certifications</a></p>   |
| <b>Worked Example 3-2</b>    | <p>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 <u>high impact or low impact</u>. Products that are meant for common areas and external works such as toilets, lobbies and landscaping areas are considered as <u>medium impact or low impact</u>.</p> <p>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.</p> <p>Example of a proposed development with the following provisions (all approved by local / international certification body:</p> <ul style="list-style-type: none"> <li>(a) Use of certified wooden doors for all dwelling units.</li> <li>(b) Use of certified bamboo flooring for all units' bedrooms.</li> <li>(c) Use of certified roof waterproofing coating.</li> </ul> |

**Table 3-2.3 : Detail calculation for credits scoring**

| 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           |

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

**RES 3-3 GREENERY PROVISION**

| <b>Objectives</b>        | Encourage greater use of greenery and restoration of existing trees to reduce heat island effect.   |   |                              |              |                      |      |     |  |                                 |                              |            |      |                         |   |              |              |
|--------------------------|---|---|------------------------------|--------------|----------------------|------|-----|--|---------------------------------|------------------------------|------------|------|-------------------------|---|--------------|--------------|
| <b>Applicability</b>     | Applicable to building developments with landscaping areas.   |   |                              |              |                      |      |     |  |                                 |                              |            |      |                         |   |              |              |
| <b>Baseline Standard</b> | -   |   |                              |              |                      |      |     |  |                                 |                              |            |      |                         |   |              |              |
| <b>Requirements</b>      | <p>Multi-storey Residential</p> <p>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.</p> <p>Green Plot Ratio (GnPR) is calculated by considering the 3D volume covered by plants using the following Leaf Area Index (LAI).</p> <p style="text-align: center;"><b>Table 3-3.1: Leaf Area Index (LAI)</b></p> <table border="1" data-bbox="371 801 1362 1137"> <thead> <tr> <th>Plant group</th> <th>Trees</th> <th>Palms</th> <th>Shrubs &amp; Groundcover</th> <th>Turf</th> </tr> </thead> <tbody> <tr> <td>LAI</td> <td>Canopy:<br/>Open = 2.5<br/>Intermediate = 3.0<br/>Dense = 4.0</td> <td>Solitary = 2.5<br/>Cluster = 4.0</td> <td>Monocot = 3.5<br/>Dicot = 4.5</td> <td>Turf = 2.0</td> </tr> <tr> <td>Area</td> <td>All = 60 m<sup>2</sup></td> <td>Solitary = 20m<sup>2</sup><br/>Cluster = 17m<sup>2</sup></td> <td>Planted area</td> <td>Planted area</td> </tr> </tbody> </table> <div style="text-align: center; margin-top: 20px;"> <p><b>TREES</b></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p><i>Santanea saman</i><br/>open canopy</p> </div> <div style="text-align: center;">  <p><i>Syzygium polyanthum</i><br/>intermediate canopy</p> </div> <div style="text-align: center;">  <p><i>Mimusops elengi</i><br/>dense canopy</p> </div> </div> <p><b>PALMS</b></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p><i>Archontophoenix alexandrae</i><br/>solitary</p> </div> <div style="text-align: center;">  <p><i>Ptychosperma macarthurii</i><br/>cluster</p> </div> </div> <div style="text-align: center; margin-top: 20px;"> <p><b>SHRUBS &amp; GROUNDCOVER</b></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p><i>Cordyline fruticosa</i><br/>'Firebrand'<br/>monocot</p> </div> <div style="text-align: center;">  <p><i>Ixora</i><br/>'Super pink'<br/>dicot</p> </div> </div> <p><b>TURF</b></p> <div style="text-align: center;">  <p><i>Zoysia matrella</i></p> </div> </div> </div> | Plant group   | Trees                        | Palms        | Shrubs & Groundcover | Turf | LAI | Canopy:<br>Open = 2.5<br>Intermediate = 3.0<br>Dense = 4.0 | Solitary = 2.5<br>Cluster = 4.0 | Monocot = 3.5<br>Dicot = 4.5 | Turf = 2.0 | Area | All = 60 m <sup>2</sup> | Solitary = 20m <sup>2</sup><br>Cluster = 17m <sup>2</sup> | Planted area | Planted area |
| Plant group              | Trees   | Palms   | Shrubs & Groundcover         | Turf         |                      |      |     |  |                                 |                              |            |      |                         |   |              |              |
| LAI                      | Canopy:<br>Open = 2.5<br>Intermediate = 3.0<br>Dense = 4.0  | Solitary = 2.5<br>Cluster = 4.0                           | Monocot = 3.5<br>Dicot = 4.5 | Turf = 2.0   |                      |      |     |  |                                 |                              |            |      |                         |   |              |              |
| Area                     | All = 60 m <sup>2</sup>   | Solitary = 20m <sup>2</sup><br>Cluster = 17m <sup>2</sup> | Planted area                 | Planted area |                      |      |     |  |                                 |                              |            |      |                         |   |              |              |

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

**Table 3-3.2 : Credits Allocation according to GnPR**

| 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                  |

Landed Homes

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

- i) 50% of non-built up area as greenery area = 1 credit
- ii) 60% of non-built up area as greenery area = 2 credits
- iii) 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 above regulatory requirements for entire development

- i) 5% more green space = 1 credit
- ii) 10% more green space = 2 credits
- iii) 15% 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.

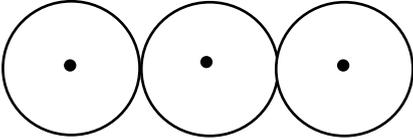
**Documentary Evidences**

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.

|                              |   |
|------------------------------|---|
|                              | <ul style="list-style-type: none"> <li>• Calculation showing percentage of greenery area compared to non-built up area.</li> </ul> <p>For 3-3 (c)</p> <ul style="list-style-type: none"> <li>• Landscape layouts showing the green space.</li> <li>• Calculation showing percentage of green space above regulatory requirements.</li> </ul> <p><u>For 3-3 (d)</u></p> <ul style="list-style-type: none"> <li>• Site layouts showing the existing and final locations (where applicable) and number of the trees to be restored or conserved or relocated.</li> </ul> <p><u>For 3-3 (e)</u></p> <ul style="list-style-type: none"> <li>• Extracts of the tender specification showing the requirements to provide compost bin</li> <li>• Product specifications.</li> <li>• Method statement with details steps of composting process (if applicable).</li> <li>• The calculation of the 30% of fertilizer replacement with the composting</li> </ul> |
| <b>Exceptions</b>            | <p><b>TREES AND PALMS SPACING (CENTRE-TO-CENTRE)</b></p> <p>(a) If the selected trees and palms are to be planted at <math>\leq 2\text{m}</math> from trunk-to-trunk as illustrated below, the leaf area shall be calculated as the product of LAI value and planted area (in <math>\text{m}^2</math>).</p> <div style="text-align: center;"> <p> —2m— </p>  </div> <p><b>COLUMNAR TREES</b></p> <p>(b) For trees that have tight, columnar crowns, the canopy area of <math>12\text{m}^2</math> is to be adopted for calculation of leaf area. These species include, but not limited to the following:</p> <ul style="list-style-type: none"> <li>• <i>Garciniacymosa forma pendula</i></li> <li>• <i>Garciniasubelliptica</i></li> <li>• <i>Polyalthialongifolia</i></li> <li>• <i>Carallia brachiate</i></li> <li>• <i>Gnetumgnemon</i></li> </ul>             |
| <b>References</b>            | National Parks Board, Singapore - <a href="http://florafaunaweb.nparks.gov.sg/">http://florafaunaweb.nparks.gov.sg/</a>   |
| <b>Worked Example 3-3(a)</b> | <p>(1) Determine the number of trees, palms and the trees for shrubs and turfs and other greenery area.</p> <p>(2) The Leaf Area Index (LAI) of the individual plant species and its canopy area are predetermined design parameters applicable for all developments.</p>   |

- (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

**Table 3-3.3: Calculation of the Green Plot Ratio**

| 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 <sup>2</sup> | 0 no.             | 0           |
|                                     | Intermediate Canopy | 3.0       | 60 m <sup>2</sup> | 8 no.             | 1440        |
|                                     | Dense Canopy        | 4.0       | 60 m <sup>2</sup> | 12 no.            | 2880        |
| Palms (no.)                         | Solitary            | 2.5       | 20 m <sup>2</sup> | 10 no.            | 500         |
|                                     | Cluster             | 4.0       | 17 m <sup>2</sup> | 10 no.            | 680         |
| Shrubs (m <sup>2</sup> )            | Monocot             | 3.5       | NA                | 0 m <sup>2</sup>  | 0           |
|                                     | Dicot               | 4.5       | NA                | 20 m <sup>2</sup> | 90          |
| Turf(m <sup>2</sup> )               | Turf                | 2.0       | NA                | 90 m <sup>2</sup> | 180         |
| Vertical Greenery (m <sup>2</sup> ) | -                   | 2.0       | NA                | 10 m <sup>2</sup> | 20          |
| <b>Total Leaf Area:</b>             |                     |           |                   |                   | <b>5790</b> |

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

Assume site area is 2000 m<sup>2</sup>

$$\text{Green Plot Ratio (GnPR)} = \text{total leaf area} / \text{site area}$$

$$= 5790 / 4000 = 2.9 < 3.0$$

Where GnPR = 2.0 to < 3.0

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

## **RES 3-4 ENVIRONMENTAL MANAGEMENT PRACTICE**

|                          |   |
|--------------------------|---|
| <b>Objectives</b>        | Encourage the adoption of environmental friendly practices during construction and building operation.  |
| <b>Applicability</b>     | Generally applicable to building developments.  |
| <b>Baseline Standard</b> | -   |
| <b>Requirements</b>      | <p>3-4(a) 1 credit can be scored if effective implementation of environmental friendly programmes including monitoring and setting targets to minimise energy use, water use and construction waste are in place during construction stage.</p> <p>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</p> <p>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).</p> <p>3-4(d) 1 credit can be scored for IBS content scoring <math>\geq 50\%</math> based on CIDB IBS scoring scheme.<br/>1 credits can be scored for IBS content scoring <math>\geq 70\%</math> based on CIDB IBS scoring scheme.</p> <p>3-4(e) Up to 1 credit if the developer, main builder, M&amp;E consultant and architect are ISO 14000 certified. 0.25 credits are allocated for each firm that is certified.</p> <p>3-4(f) 1 credit if the project team comprises Certified GreenRE Manager/ Green Mark Manager</p> <p>3-4(g) 1 credit can be scored for the provision of building users' guide with details of the environmental friendly facilities and features within the building and their uses in achieving the intended environment performance during building operation.<br/>The minimum requirement of the Green Building User Guide as follows;</p> <ul style="list-style-type: none"> <li>• Details of green building certification i.e rating tier, scorecard, certificate, validity etc.</li> <li>• Summary of green building features (ideally with photographs and diagrams)</li> <li>• Recommended practices for enhanced environmental</li> </ul> |

|  |   |
|--|---|
|  | <p>performance of residence (refer to greenre green home user guide)</p> <ul style="list-style-type: none"> <li>• Recommended practices for enhanced occupant health and wellbeing (refer to greenre green home user guide)</li> <li>• Green fit out guidelines to details recommended minimum environmental standard to assist building users in making sustainable fit out decisions</li> </ul> <p>3-4(h) 1 credit can be scored for provision of Sustainable Operation Management Guideline (SOMG) and also 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;</p> <ul style="list-style-type: none"> <li>• Recommended performance standards to assist building users in making sustainable fit out decisions.</li> <li>• Energy management and monitoring plan – common areas</li> <li>• Water management and monitoring plan – common areas</li> <li>• Waste management plan including details of recycling facilities – entire development</li> <li>• Environmental policy and cleaning strategies / schedule – common areas</li> <li>• Pandemic response plan (e.g increased cleaning requirements, closure of common facilities, signages etc)</li> </ul> <p>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.</p> <p>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 residents</p> |
|--|---|

|                                     |   |
|-------------------------------------|---|
| <p><b>Documentary Evidences</b></p> | <p><u>For 3-4(a)</u></p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Details of the environmental friendly programmes implemented.</li> </ul> <p><u>For 3-4(b)</u></p> <ul style="list-style-type: none"> <li>• Main builder's track records details in the adoption of sustainable, environmentally friendly and considerate practices during construction.</li> </ul> <p><u>For 3-4(c)</u></p> <ul style="list-style-type: none"> <li>• Extracts of the tender specification showing the requirement to adopt Quality Assessment System in Construction (QLASSIC) where applicable with minimum score of 70%.</li> <li>• QLASSIC certificate</li> </ul> <p><u>For 3-4(d)</u></p> <ul style="list-style-type: none"> <li>• A copy of CIDB IBS Score form.</li> </ul> <p><u>For 3-4(e)</u></p> <p>A certified true copy of the ISO 14000 certificate of developer, main contractor, M &amp; E consultant and architect where applicable.</p> <p><u>For 3-4(f)</u></p> <ul style="list-style-type: none"> <li>• A certified true copy of the certificate of GreenRE Manager/ Green Mark Manager and Green Mark Professional where applicable and a confirmation of their involvement performance during building operation.</li> </ul> <p><u>For 3-4(g)</u></p> <ul style="list-style-type: none"> <li>• 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.</li> </ul> <p><u>For 3-4(h)</u></p> <ul style="list-style-type: none"> <li>• A copy of of Sustainable Operation Management Guideline (SOMG) and also at least one session of briefing to be conducted to the Building Management Team.</li> </ul> <p><u>For 3-4(i)</u></p> <ul style="list-style-type: none"> <li>• Plan layout showing the location of the recycling bins for collection and storage of different recyclable waste.</li> <li>• Product catalogue.</li> </ul> |
| <p><b>References</b></p>            | <p>-</p>  |

## RES 3-5 GREEN TRANSPORT

|                              |  |
|------------------------------|--|
| <b>Objectives</b>            | Promote environmental friendly transport options and facilities to reduce pollution from individual car use.   |
| <b>Applicability</b>         | Generally applicable to all building developments.   |
| <b>Baseline Standard</b>     | -  |
| <b>Requirements</b>          | <p>3-5(a) 1 credit can be scored for design that provides good access (&lt;800m walking distance) to public transport networks such as MRT/LRT stations or bus stops.</p> <p>3-5(b) 1 credit can be scored for provision of covered walkway to facilitate connectivity and the use of public transport.</p> <p>3-5(c) 1 credit can be scored for provision of infrastructure for electric charging stations to at least 10% of available parking spaces. Provision of minimum of isolator with 7kWp charger</p> <p>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</p> <p>Extent of coverage:<br/>Minimum 1 number priority parking bays for every 100 carpark lots. EV chargers – 1 for every 200 parking bays. (Cap at 3)</p> <p>3-5(e) Up to 1 credit can be scored for the provision of covered/sheltered bicycles parking lots with rack / locking bar.</p> <p>Credits scored based on the number of bicycle parking bays provided.</p> <p>1 credit for the provision of <math>\geq 10\%</math> x number of dwelling units</p> <p>0.5 credits for the provision <math>\geq 5\%</math> x number of dwelling units</p> |
| <b>Documentary Evidences</b> | <p><u>For 3-5(a)</u><br/>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.</p> <p><u>For 3-5(b)</u></p> <ul style="list-style-type: none"> <li>• Site layout plan showing the connection of covered walkway from the development to the MRT/LRT stations or bus stops.</li> <li>• Extracts of the tender specification showing the requirement to provide covered walkway.</li> </ul>  |

|                   |  |
|-------------------|--|
|                   | <p><u>For 3-5(c)</u></p> <ul style="list-style-type: none"> <li>• Extracts of the tender specification showing the requirement to provide electric charging stations.</li> <li>• Plan layout showing the location of the electric charging station in the development.</li> <li>• Calculation showing infrastructure for electric charging stations is at least 10% of available parking spaces.</li> <li>• Product technical information.</li> </ul> <p><u>For 3-5(d)</u></p> <ul style="list-style-type: none"> <li>• Extracts of the tender specification showing the requirement to provide hybrid/electric vehicle refuelling/recharge stations and priority carparking bays.</li> <li>• Plan layout showing the location of the electric vehicle charging station in the development.</li> <li>• Product technical information.</li> </ul> <p><u>For 3-5(e)</u></p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Plan layout showing the location of the covered/sheltered bicycle parking lots.</li> </ul> |
| <b>References</b> | -  |

**RES 3-6 STORMWATER MANAGEMENT**

|                              |   |
|------------------------------|---|
| <b>Objectives</b>            | Encourage the treatment of stormwater runoff through provision of infiltration or design features before discharge to public drains.  |
| <b>Applicability</b>         | Generally applicable to building developments.  |
| <b>Baseline Standard</b>     | -   |
| <b>Requirements</b>          | <p>Up to 3 credit 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.</p> <p><b>Note:</b> The treatment of stormwater runoff shall be through provision of infiltration or design features as recommended in Urban Storm Water Management (MSMA).</p>                      |
| <b>Documentary Evidences</b> | <ul style="list-style-type: none"> <li>• 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.</li> <li>• Approved Urban Storm Water Management (MSMA) report complying to Storm Water Best Management Manual</li> </ul> |
| <b>References</b>            | MSMA – Urban Storm Water Management   |

### **RES 3-7 INTERNET CONNECTIVITY**

|                              |   |
|------------------------------|---|
| <b>Objectives</b>            | Encourage working from home via internet connection, thereby discouraging commuting.  |
| <b>Applicability</b>         | Applicable to all dwelling units in the development.  |
| <b>Baseline Standard</b>     | -   |
| <b>Requirements</b>          | 1 credit can be scored if infrastructure for high speed broadband is provided to all dwelling units.  |
| <b>Documentary Evidences</b> | <ul style="list-style-type: none"><li>• Infrastructure telecommunication layout plan showing the location of optical fibre for internet connected to every dwelling unit.</li><li>• Letter of confirmation from service provider.</li></ul> |
| <b>References</b>            | -   |

### **RES 3-8 COMMUNITY CONNECTIVITY**

|                              |   |
|------------------------------|---|
| <b>Objectives</b>            | Encourage development in urban area with existing infrastructure to minimise the use of private mode of transportation.   |
| <b>Applicability</b>         | Generally applicable to building developments.  |
| <b>Baseline Standard</b>     | -   |
| <b>Requirements</b>          | <p>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:</p> <ul style="list-style-type: none"> <li>• Bank</li> <li>• Beauty</li> <li>• Convenience/Grocery</li> <li>• Day care</li> <li>• Fire Station</li> <li>• Hardware</li> <li>• Laundry</li> <li>• Library</li> <li>• Police station</li> <li>• Park</li> <li>• Pharmacy</li> <li>• Post Office</li> <li>• Restaurant</li> <li>• School</li> <li>• Supermarket</li> <li>• Clinic</li> </ul> |
| <b>Documentary Evidences</b> | <ul style="list-style-type: none"> <li>• Site layout plan showing the location of the development site and the location of Basic Services mentioned above.</li> </ul>   |
| <b>References</b>            | -   |

## (II) Other Green Requirements

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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

| <b>Objectives</b>  | 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.  |             |                                |  |         |  |         |
|--|--|-------------|--------------------------------|--|---------|--|---------|
| <b>Applicability</b>   | Generally applicable to building developments.   |             |                                |  |         |  |         |
| <b>Baseline Standard</b>   | ASTEM E413 or equivalent   |             |                                |  |         |  |         |
| <b>Requirements</b>  | <p>1 credit can be scored if the building is designed to achieve ambient internal noise level as specified:</p> <ul style="list-style-type: none"> <li>• 55dB (6am – 10pm) <math>L_{Aeq}</math></li> <li>• 45dB (10pm – 6 am) <math>L_{Aeq}</math></li> </ul> <p>This can be achieved by adhering to the following STC values for residential building partitions</p> <table border="1" data-bbox="432 898 1326 1223"> <thead> <tr> <th data-bbox="432 898 1023 994">Description</th> <th data-bbox="1023 898 1326 994">Sound Transmission Class (STC)</th> </tr> </thead> <tbody> <tr> <td data-bbox="432 994 1023 1128">Separation between functional spaces within dwelling units and in-between adjacent dwelling units.</td> <td data-bbox="1023 994 1326 1128">40 - 50</td> </tr> <tr> <td data-bbox="432 1128 1023 1223">Spaces between mechanical and equipment spaces and occupied spaces</td> <td data-bbox="1023 1128 1326 1223">50 - 60</td> </tr> </tbody> </table> <p>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.</p> | 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 |
| 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  |             |                                |  |         |  |         |
| <b>Documentary Evidences</b>   | <ul style="list-style-type: none"> <li>• Extracts of the tender specification showing the requirement to design the occupied space with the ambient sound levels.</li> <li>• Typical layout with walls and floors noise attenuation properties clearly marked. STC values to be clearly marked.</li> </ul>   |             |                                |  |         |  |         |
| <b>References</b>  | -  |             |                                |  |         |  |         |

## **RES 4-2 INDOOR AIR POLLUTANTS**

|                              |   |
|------------------------------|---|
| <b>Objectives</b>            | Minimise airborne contaminants, mainly from inside sources to promote a healthy indoor environment.   |
| <b>Applicability</b>         | Generally applicable to building developments.  |
| <b>Baseline Standard</b>     | -   |
| <b>Requirements</b>          | <p>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.</p> <p>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.</p>   |
| <b>Documentary Evidences</b> | <p><u>For 4-2(a)</u></p> <ul style="list-style-type: none"> <li>• Extracts of the tender specification showing the requirement to use low VOC paints that are certified by approved local/ international certification body or equivalent.</li> <li>• Technical product information</li> </ul> <p><u>For 4-2(b)</u></p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Product catalogue.</li> <li>• Product certificate.</li> </ul> |
| <b>References</b>            | -   |

### RES 4-3 WASTE DISPOSAL

|                              |   |
|------------------------------|---|
| <b>Objectives</b>            | Minimise airborne contaminants from waste.  |
| <b>Applicability</b>         | Generally applicable to building developments.  |
| <b>Baseline Standard</b>     | -   |
| <b>Requirements</b>          | <u>For Multi-storey Residential</u><br>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<br><br><u>For Landed Homes</u><br>1 credit can be scored for provision of space that is naturally ventilated in a convenient location for kerbside collection. |
| <b>Documentary Evidences</b> | <ul style="list-style-type: none"><li>• Plan layouts showing the location of the refuse chutes for all typical dwelling units.</li><li>• Technical product information if applicable.</li></ul>   |
| <b>References</b>            | -   |

#### **RES 4-4 INDOOR AIR QUALITY IN WET AREAS**

|                              |  |
|------------------------------|--|
| <b>Objectives</b>            | Encourage provision of adequate natural ventilation and day lighting in wet areas.   |
| <b>Applicability</b>         | Generally applicable to all wet areas such as kitchens, bathroom and toilets of the development.   |
| <b>Baseline Standard</b>     | -  |
| <b>Requirements</b>          | 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. <ul style="list-style-type: none"><li>• 2 credits for more than 90% of all applicable areas.</li><li>• 1 credit for at least 50% to 90% of all applicable areas.</li></ul> |
| <b>Documentary Evidences</b> | <ul style="list-style-type: none"><li>• Plan layouts showing the location of the window openings of the kitchens, bathrooms and toilets for all typical dwelling units.</li><li>• Calculation showing the total number of dwelling units with good natural ventilation.</li></ul>  |
| <b>References</b>            | -  |

## (II) Other Green Requirements

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### Part 5 – Other Green Features

## **RES 5-1 GREEN FEATURES & INNOVATIONS**

|                          |  |
|--------------------------|--|
| <b>Objectives</b>        | 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.  |
| <b>Applicability</b>     | Generally applicable to all building development.  |
| <b>Baseline Standard</b> | -  |
| <b>Requirements</b>      | <p>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.</p> <p><u>Water efficiency</u></p> <ul style="list-style-type: none"> <li>i. Use of self-cleaning façade system <ul style="list-style-type: none"> <li>• 2 credits for more than 75% of the applicable facades areas</li> <li>• 1 credit for more than 50% of the applicable facades areas</li> <li>• 0.5 credit for at least 25% of the applicable facades areas</li> </ul> </li> <li>ii. Use of integrated basin/cistern pedestal system <ul style="list-style-type: none"> <li>• 2 credit s for more than 50% of all dwelling units' flushing cisterns</li> <li>• 1 credit for more than 25% of all dwelling units' flushing cisterns</li> <li>• 0.5 credit for at least 10% of all dwelling units' flushing cisterns</li> </ul> </li> <li>iii. Use of grey water recycling system <ul style="list-style-type: none"> <li>• 2 credits for all blocks of the development.</li> <li>• 1 credit for at least one block of the development.</li> </ul> </li> <li>iv. Provision of system to recycle surface runoff from the vertical green wall and sky garden <ul style="list-style-type: none"> <li>• 1 credit for at least 25% of the green areas</li> <li>• 0.5 credit for less than 25% of the green areas</li> </ul> </li> <li>v. Use of water efficient washing machine with WEPLS “Efficient” rating and above <ul style="list-style-type: none"> <li>• 1 credit for more than 90% of all dwelling units.</li> <li>• 0.5 credit for at least 50% of all dwelling units.</li> </ul> </li> </ul> <p><u>Environmental Protection</u></p> <ul style="list-style-type: none"> <li>i. Use of precast toilet <ul style="list-style-type: none"> <li>• 2 credits for more than 75% of all toilets</li> <li>• 1 credit for more than 50% of all toilets</li> <li>• 0.5 credit for at least 25% of all toilets</li> </ul> </li> <li>ii. Provision of green roof and roof top garden <ul style="list-style-type: none"> <li>• 1 credit for more than 50% of the roof areas</li> <li>• 0.5 credit or at least 25% of the roof areas</li> </ul> </li> <li>iii. Provision of vertical greening <ul style="list-style-type: none"> <li>• 1 credit for more than 50% of the external wall areas</li> <li>• 0.5 credit for at least 25% of the external wall areas</li> </ul> </li> </ul> |

|                              |  |
|------------------------------|--|
|                              | <p>iv. 1 credit for the provision of double refuse chutes for separating recyclable from non-recyclable waste.</p> <p>v. 0.5 credit for the use of non-chemical termite treatment system.</p> <p>vi. Conservation of existing building structure or building envelope (by areas).</p> <ul style="list-style-type: none"> <li>• 2 credits for conserving more than 50% of the existing structure or building envelope</li> <li>• 1 credit for conserving at least 25% of the existing structure or building envelope</li> </ul> <p>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)</p> <p>viii. Adoption of demolition protocol to maximise resource recovery of demolition materials for reuse or recycling.</p> <ul style="list-style-type: none"> <li>• 2 credits for recovery rate of more than 35% crushed concrete waste to be sent to the approved recycles with proper facilities</li> <li>• 1 credit for recovery rate at least 20% crushed concrete waste to be sent to the approved recyclers with proper facilities</li> </ul> <p><u>Indoor Air Quality</u><br/>1 credit for the use of pneumatic waste collection system.</p> <p><u>Others</u><br/>0.5 credit for the use of siphonic rainwater discharge system at roof.<br/><b>Notes:</b> 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.</p> |
| <b>Documentary Evidences</b> | <ul style="list-style-type: none"> <li>• Extracts of the tender specification showing the provision of the specific green features used and the extent of implementation where applicable.</li> <li>• Technical product information (including drawing and supporting documents) of the green features.</li> <li>• Quantified evidences on the potential environmental benefits that the features can bring to the development.</li> </ul>   |
| <b>References</b>            | -  |

## (II) Other Green Requirements

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Part 6 – Carbon Emission of Development

## RES 6-1 CARBON EMISSION OF DEVELOPMENT

| <b>Objectives</b>            | To calculate the carbon emission resulted from the associated energy used during construction and operational phase of a development.  |                      |                    |                      |          |         |           |                  |         |           |            |        |        |                           |                  |                  |
|------------------------------|--|----------------------|--------------------|----------------------|----------|---------|-----------|------------------|---------|-----------|------------|--------|--------|---------------------------|------------------|------------------|
| <b>Applicability</b>         | Generally applicable to all building development.  |                      |                    |                      |          |         |           |                  |         |           |            |        |        |                           |                  |                  |
| <b>Baseline Standard</b>     | -  |                      |                    |                      |          |         |           |                  |         |           |            |        |        |                           |                  |                  |
| <b>Requirements</b>          | <p>1 credit can be scored for the calculation of the carbon footprint report of the building comprising of energy and water consumption savings with comparison of the baseline parameters.</p> <p>1 credit – Carbon footprint calculation of glass, steel and concrete.</p> <p>0.25 credits for every additional material declared up to 1 credit</p>   |                      |                    |                      |          |         |           |                  |         |           |            |        |        |                           |                  |                  |
| <b>Documentary Evidences</b> | <p><u>For 6-1 (a)</u></p> <ul style="list-style-type: none"> <li>• Detail calculation for the estimated energy load for each component in the building e.g.: lighting, air-conditioning system, pump, receptacle load.</li> <li>• Details calculation for estimated water consumption of the building e.g.: water fittings, landscape, water features.</li> <li>• Technical product information on the energy efficient features and water efficient features used.</li> <li>• Summary tabulation of estimated total energy savings and total water savings of the development for the year.</li> <li>• Carbon emission calculation.</li> </ul> <p><u>For 6-1 (b)</u></p> <ul style="list-style-type: none"> <li>• Embodied carbon footprint calculation</li> </ul>  |                      |                    |                      |          |         |           |                  |         |           |            |        |        |                           |                  |                  |
| <b>References</b>            | -  |                      |                    |                      |          |         |           |                  |         |           |            |        |        |                           |                  |                  |
| <b>Worked Example 6-1</b>    | <p>Energy Consumption</p> <table border="1" style="margin-left: 40px;"> <thead> <tr> <th style="width: 40%;">Type of usage</th> <th style="width: 30%;">Design<br/>(kWh/yr)</th> <th style="width: 30%;">Baseline<br/>(kWh/yr)</th> </tr> </thead> <tbody> <tr> <td>Lighting</td> <td style="text-align: center;">819,498</td> <td style="text-align: center;">1,151,575</td> </tr> <tr> <td>Air-Conditioning</td> <td style="text-align: center;">860,589</td> <td style="text-align: center;">1,406,899</td> </tr> <tr> <td>M/V System</td> <td style="text-align: center;">25,550</td> <td style="text-align: center;">25,550</td> </tr> <tr> <td><b>Total Energy Usage</b></td> <td style="text-align: center;"><b>1,705,637</b></td> <td style="text-align: center;"><b>2,584,024</b></td> </tr> </tbody> </table> <p>Water Consumption<br/>(Please refer GreenRE Water Calculator)</p> | Type of usage        | Design<br>(kWh/yr) | Baseline<br>(kWh/yr) | Lighting | 819,498 | 1,151,575 | Air-Conditioning | 860,589 | 1,406,899 | M/V System | 25,550 | 25,550 | <b>Total Energy Usage</b> | <b>1,705,637</b> | <b>2,584,024</b> |
| Type of usage                | Design<br>(kWh/yr)   | Baseline<br>(kWh/yr) |                    |                      |          |         |           |                  |         |           |            |        |        |                           |                  |                  |
| Lighting                     | 819,498  | 1,151,575            |                    |                      |          |         |           |                  |         |           |            |        |        |                           |                  |                  |
| Air-Conditioning             | 860,589  | 1,406,899            |                    |                      |          |         |           |                  |         |           |            |        |        |                           |                  |                  |
| M/V System                   | 25,550   | 25,550               |                    |                      |          |         |           |                  |         |           |            |        |        |                           |                  |                  |
| <b>Total Energy Usage</b>    | <b>1,705,637</b>   | <b>2,584,024</b>     |                    |                      |          |         |           |                  |         |           |            |        |        |                           |                  |                  |

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

Carbon Footprint

| Type of usage                 | Design                 | Baseline               |
|-------------------------------|------------------------|------------------------|
|                               | kgCO <sub>2</sub> e/yr | kgCO <sub>2</sub> e/yr |
| Energy                        | 1,226,619              | 1,860,497              |
| Water                         | 155,344                | 241,192                |
| Total Annual Carbon Footprint | 1,381,963              | 2,101,689              |

Energy CO<sub>2</sub> Emission Reduction (ktCO<sub>2</sub>e/annum, based on electricity energy reduction only @ 1kWh =

- 0.694 kg CO<sub>2</sub>- Peninsular
- 0.699 kg CO<sub>2</sub>- Sarawak
- 0.536 kg CO<sub>2</sub>- Sabah)

*Water CO<sub>2</sub> Emission Reduction = 0.02*

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

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

Embodied carbon calculation

| No | Material       | Description                                  | tCO <sub>2</sub> e |                | Quantity | Total tCO <sub>2</sub> e |
|----|----------------|--|--------------------|----------------|----------|--------------------------|
|    |                |  | Value              | Unit           |          |                          |
| 1  | Concrete (G30) | Slab   | 0.309              | m <sup>3</sup> | 9876.19  | 3051.74                  |
| 2  | Glass          | 10mm of Glass (Single Glass excluding Frame) | 0.035              | m <sup>2</sup> | 4500.00  | 157.50                   |
| 3  | Steel          | Rebar  | 1.2                | kg             | 5000.00  | 6000.00                  |
|    |                |  |                    |                |          |                          |
|    | <b>Total</b>   |  |                    |                |          | <b>9209.24</b>           |

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

The project entitled = 2 credit

## 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.

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

| GreenRE Criteria   | Required Signatories |
|--|----------------------|
| <b>Part 1 – Energy Efficiency</b>  |                      |
| RES 1-1 Thermal Performance of Building Envelope- RETV   | PA                   |
| RES 1-2 Naturally Ventilated Design and Air-Conditioning System <ul style="list-style-type: none"> <li>• Dwelling Unit Comfort               <ul style="list-style-type: none"> <li>- Ventilation Simulation/ Design</li> <li>- Use of energy efficient air conditioners</li> </ul> </li> <li>• Natural Ventilation in Common Areas</li> </ul> | PA<br>PE<br>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 <ul style="list-style-type: none"> <li>• Heat Recovery Devices</li> <li>• Motion Sensors/ Photo Sensors</li> <li>• Others</li> </ul>   | PE<br>PE<br>S        |
| RES 1-8 Renewable Energy   | S                    |
| <b>Part 2 – Water Efficiency</b>   |                      |
| RES 2-1 Water Efficient Fittings   | PA                   |
| RES 2-2 Water Usage Monitoring   | PE                   |
| RES 2-3 Irrigation System and Landscaping  | PE                   |
| <b>Part 3 – Environmental Protection</b>   |                      |
| 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                   |
| <b>Part 4 – Indoor Environmental Quality</b>   |                      |
| 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                   |
| <b>Part 5 – Other Green Features</b>   |                      |
| RES 5-1 Green Features & Innovations   | S                    |
| <b>Part 6 – Carbon Emission of Development</b>   |                      |
| RES 6-1 Carbon Emission of Development   | S                    |

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, Engineer or Sustainable consultant and Commissioning Specialist



**Appendix A**  
**VENTILATION SIMULATION METHODOLOGY**  
**AND REQUIREMENTS**

## **A1 General**

The natural ventilation simulation shall be carried out using computational fluid dynamics (CFD) modelling to identify the most effective building design and layout for the development. The simulation results and recommendations derived are to be adopted to meet the intent of the criteria.

## **A2 Simulation Software**

The CFD modelling shall be carried out using well validated software. The CFD solver shall have the minimum capability of solving the Navier-Stokes fluid flow equations for a three-dimensional incompressible flow at steady state on a body conforming computational grid. Turbulence modelling shall also be included with the minimum requirement of using the standard k- $\epsilon$  turbulence model, coupled with standard wall function.

## **A3 Ventilation Simulation Methodology**

A3.1 All simulation shall be carried out under isothermal condition of 33.0°C air temperature at steady state condition.

A3.2 The computational domain shall include the development of interest, the characteristics of the immediate surroundings and buildings reside within the proximity of minimum 3 times or more the length of the longest distance measured across the boundary of the development. In the event that the building and surrounding development are located within hilly terrain, the topography information shall also be included in the simulation models. The computational domain shall be further extended from the outer edge of the proximity regions to the boundary such that it would not result in non-physical airflow solution, after the solution has converged. The computational domain shall also be aligned along with the wind flow direction. The domain height shall be extended, approximately 3 times the height of the tallest building within the defined vicinity.

A3.3 The computational grid generated for all simulations should resolve the salient flow features in the apartment units and around the development. As a guide, the dimension of the computational elements should be set at 0.1 to 0.2m in the apartment unit, 0.5 to 1.0m at all buildings and ground level and 10m at the far field boundary with a minimum 50m away from the ground.

A3.4 Based on local climatic wind condition, meteorological data on the precise wind direction and velocity of the proposed site location for the month of December, March, June and September shall be used for the CFD simulation. The prevailing wind condition such as the mean speed and direction for Malaysia shall be taken from local prevailing wind data downloadable from GreenRE website. The inbound vertical wind profile shall assume to be given by the Logarithmic Law reference height at 15.0m

A3.5 There shall have two large scale simulation models using the specified computational domain and grid stated in paragraph A3.2 and A3.3, to assess the wind flow conditions and air-flow pattern within the development and units. The simulation modelling can be conducted based on the two best prevailing wind directions for the building development.

|   |  |
|---|--|
| <p>Stage 1<br/>CFD<br/>Simulation<br/>model for<br/>development</p> | <ul style="list-style-type: none"> <li>i. Determine up to five (5) typical unit design layouts that have the majority number of units. If the proposed building development comprises less than 5 typical types, all the typical unit design layout are to be selected for the simulation.</li> <li>ii. Conduct a large scale CFD simulation to assess the wind flow conditions around the proposed building development and adjacent buildings. Natural ventilated corridor linked to the unit should be taken into consideration for the simulation models.</li> <li>iii. From the simulation results, determine the wind pressure taken at 0.5m from every assumed opening of all units at mid height level (capped at 20 storey height) and the pressure difference (i.e. the difference of the maximum and minimum wind pressure) of each unit. In instances, where all or some of the typical unit layouts are not designed at mid-height level, the average wind pressure and respective pressure differences should be determined for these typical units located at the level closest to the mid-height level.</li> <li>iv. Derive the average pressure difference of all units at mid-height or selected level.</li> <li>v. Select the unit with pressure difference that is closest to the average pressure difference derived in A3.5 (iv) from each typical unit design layout as determined in A3.5 (i) for Stage 2 simulation. The maximum allowable margin of <math>\pm 10\%</math> difference from the average pressure difference is deemed acceptable.</li> </ul> |
| <p>Stage 2<br/>CFD<br/>Simulation<br/>model for</p>                 | <ul style="list-style-type: none"> <li>vi. Conduct a large scale CFD simulation to assess the air flow conditions of these five (5) selected units. All living or functional spaces in the unit are to be included in the simulation modelling except for enclosed spaces such as</li> </ul>   |

|       |  |
|-------|--|
| units | <p>storeroom or CD shelter. For the simulation model, all windows and doors are assumed to be fully opened except for the main door, which is assumed to be closed at all time.</p> <p>vii. From the simulation results, determine the area-weighted average wind velocity of each selected unit by considering the air flow conditions of the applicable areas. For residential buildings, the applicable areas refer to living room, open kitchen (that is connected to the living room), study rooms and all bedrooms. The area-weighted average wind velocities of these areas are to be computed at horizontal-plane 1.2m above the floor level. The same applies to naturally ventilate functional spaces for non-residential buildings.</p> |
|-------|--|

A3.6 The selected unit is deemed to have good natural ventilation if the area-weighted average wind velocity of the unit is not less than 0.6 m/s. The overall percentage of units achieving good natural ventilation is given by:

$$\frac{\sum(\text{No. of Selected Units for Each Layout} \times \text{Area-Weighted Average Wind Velocity})}{\text{Total Number of Selected Units} \times 0.60 \text{ m/s}} \times 100$$

## **A4 Documentation Requirements**

A4.1 The Qualified Person (QP) and the other appropriate practitioners shall ensure that the following report is available as evidences to demonstrate compliance with the ventilation simulation framework. The report should comprise the following items:

- i. Cover page with a proper title, photo of development, developers' information (including developers' name and address and person-in-charge), Consultant's detail (including the principal's name and authorized signature, firm's address and person-in-charge)
- ii. Table of Content
- iii. Executive Summary
  - Background of the development
  - Main findings
  - Concluding remarks
- iv. Background/Introduction
- v. Methodology
  - Describe methodology used in the study
  - Provide the rationale for the unit's selection as well as salient information such as the total no. of units and different design units layout and location
- vi. Geometrical Model should include
  - Isometric view of the development from various angles
  - Domain size used
  - Plan and 3D isometric model of units from various angles
- vii. Simulation settings
  - Boundary conditions
  - CFD software/models used/numerical scheme
  - Mesh/cell sizing
  - Solution control-converge criteria

viii. Result and discussions

- Simulation results for development for all directions showing the main graphical plots of the plan pressure and velocity vector and salient findings
- Tabulation showing the listing and details of all typical unit types and the selected unit types as well as the corresponding number of units and the area-weighted average wind velocity within each selected unit where applicable.
- Calculation of percentage of units with good natural ventilation and area-weighted average wind velocity of 0.60 m/s or more.

ix. Conclusion

x. The following plots are to be placed in the appendixes

- Simulation results for the development (done for each direction)
  - Static pressure (plan view-ground & mid elevation, isometric views on building facade)
  - Velocity vectors and contour showing the plan view at ground & mid elevation and a few isometric sectionals cut plans to show air-flow patterns across the development
- Simulation results for the units for each direction
  - Static pressure (plan view-ground & mid elevation)
  - Velocity vectors and contour showing the plan view at ground & mid elevation