Building and Construction Authority

We shape a **safe**, **high quality**, **sustainable** and **friendly** built environment.

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Technology Development Group
Tel : 6325 5921
Fax: 6325 4800
Email: tan_tian_chong@bca.gov.sg

CIRCULAR TO PROFESSIONAL INSTITUTES / ASSOCIATIONS

REVISED BCA GREEN MARK CRITERIA FOR NEW BUILDINGS (GM VERSION 4.1)

Objective

1 This circular is to inform the industry on the revision of the Green Mark standards for new buildings.

Background

2. As part of our on-going review process, BCA has been engaging our industry on possible improvements to the environmental sustainability standard set. Over the last two years, BCA received suggestions to further enhance the BCA Green Mark Criteria for greater flexibility and better adoption of resource-efficient design and practices. These suggestions were reviewed by BCA, the Green Mark Advisory Committee and technical taskforces and the enhancements necessary were incorporated under the BCA Green Mark Criteria for New Buildings – GM Version 4.1 for implementation.

Details of the Revision

3. This revision mainly comprises the following aspects :

- Enhancement of the air-conditioning system requirement and methodology to facilitate better energy building performance during operation.
- Consideration for passive design enhancement and small air distribution system in energy modeling framework.
- Prerequisite requirement on the use of sustainable products and introduction of new criteria on energy efficient products or equipment
- Simplified requirement for ventilation simulation methodology.
- Improvement to the scoring methodology for sustainable construction.

4 There were also changes to make clear certain requirements in response to the common queries raised during Green Mark assessment. To facilitate better understanding, we have enclosed Annex A summarising the main changes and additions to the Green Mark Criteria for your reference. More detailed explanation on the criteria can be found in the BCA Green Mark Certification Standard for new buildings available in our website at http://www.bca.gov.sg/EnvSusLegislation/others/GM_Certification_Std2012.pdf

Implementation Timeline

5. The revised BCA Green Mark Criteria for new buildings (GM Version 4.1) will come into effect on 15 Jan 2013. All Green Mark applications for new buildings that are submitted on or after this date will be assessed and certified based on GM Version 4.1. For project with applications that are submitted before 15 Jan 2013, a grace period of 9 months (i.e.by 15 Oct 2013) will be given to complete the Green Mark assessment based on GM Version 4. The revised GM Version 4.1 will apply if the projects are not assessed within the stipulated timeline

6. The implementation timeline for adoption of BCA Green Mark Criteria Version 4.1 for other green building initiatives are listed below :

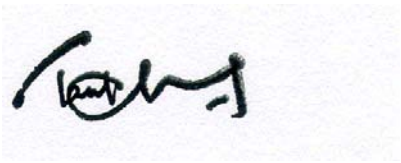
Green Building Initiatives	Implementation Timeline
• Green Mark Gross Floor Area (GM-GFA) Incentive Scheme Incentives in the form of additional GFA can be granted by URA if development attains Green Mark Gold^{Plus} or Platinum Rating	• Based on the submission date of BCA -GM-GFA application. • Projects with GM-GFA applications submitted on or after 15 Jan 2013 will be assessed and certified using the Revised BCA Green Mark Criteria for new buildings (GM Version 4.1). • Projects with GM-GFA applications submitted before 15 Jan 2013, a grace period of 9 months (i.e. by 15 Oct 2013) will be given to complete the Green Mark assessment based on GM Version 4. The revised GM Version 4.1 will apply if the projects are not assessed within the stipulated timeline.
• Public Sector Taking the Lead New public sector buildings with more than 5,000 m^2 air-conditioned floor area are required to attain the Green Mark Platinum Rating	• Based on the date of tender notices for the consultancy or design and build contract. • The revised BCA Green Mark Criteria for new buildings (GM Version 4.1) will be applicable to public sector projects with tenders for design that are called on or after 15 Jan 2013. • For projects with tenders for design called before 15 Jan 2013, a grace period of 9 months (i.e. by 15 Oct 2013) will be given to complete the Green Mark assessment based on GM Version 4. The revised GM Version 4.1 will apply if the projects are not assessed within the stipulated timeline.

For Clarification

7. We would appreciate it if you could convey the contents of this circular to members of your organization. For clarification, you may email to bca_enquiry@bca.gov.sg or contact the following officers :

Subject Matter	Name	Email	Contact No.
Green Mark Certification and Criteria	Grace Cheok	grace_cheok-chan@bca.gov.sg	63257588
BCA GM-GFA Incentive Scheme	Jolene Chong	jolene_chong@bca.gov.sg	67304456
Public Sector Taking the Lead Initiatives	Michelle Tan	michelle_tan@bca.gov.sg	63255953

Thank you.



TAN TIAN CHONG
GROUP DIRECTOR
TECHNOLOGY DEVELOPMENT GROUP
for CHIEF EXECUTIVE OFFICER
BUILDING AND CONSTRUCTION AUTHORITY

DISTRIBUTION (via e-mail):

President
Real Estate Developer Association of Singapore (REDAS)
190 Clemenceau Avenue
#07-01 Singapore Shopping Centre
Singapore 239924
enquiry@redas.com

President
Singapore Institute of Architects (SIA)
79 Neil Road
Singapore 088904
info@sia.org.sg

President
Institution of Engineers, Singapore (IES)
70, Bukit Tinggi Road
Singapore 289758
iesnet@singnet.com.sg

President
Association of Consulting Engineers Singapore (ACES)
Thomson Road Post Office
PO Box 034
Singapore 915702
secretariat@aces.org.sg

President
Singapore Contractors Association Limited (SCAL)
1 Bukit Merah Lane 2
Construction House
Singapore 159760
enquiry@scal.com.sg

President
Society of Project Managers (SPM)
Macpherson Road P.O.Box 1083
Singapore 913412
sprojm@yahoo.com

President
Singapore Institute of Building Limited (SIBL)
70 Palmer Road,
#03-09C Palmer House
Singapore 079427
josephine@sib.com.sg

President
Singapore Institute of Surveyors & Valuers (SISV)
20 Maxwell Road, #10-09B, Maxwell House
Singapore 069113
sisv.info@sisv.org.sg

President
Singapore Institute of Planners (SIP)
71A Kampong Bahru Road
Singapore 169373
info@sip.org.sg

President
Association of Property & Facility Managers (APFM)
20 Maxwell Road, #10-09B Maxwell House
Singapore 069113
apfm@pacific.net.sg

Registrar
Board of Architects (BOA)
5 Maxwell Road 1st storey
Tower Block MND Complex
Singapore 069110
boarch@singnet.com.sg

Registrar
Professional Engineers Board, Singapore
5 Maxwell Road
1st Storey Tower Block MND Complex
Singapore 069110
registrar@peb.gov.sg

All CORENET e-info subscribers

Annex A

Summary of the Main Changes

Green Mark for New Residential Building Criteria
Green Mark for New Non-Residential Building Criteria

Criteria / Requirements	Green Mark Version RB 4.0	Green Mark Version RB 4.1
1. VENTILATION SIMULATION METHODOLOGY Pre-requisite Requirement RB 1-2 APPENDIX C	1.1 To be eligible for Green Mark Platinum rating, it is a requirement to use ventilation simulation modeling and analysis to identify the most effective building design and layout. A minimum 80% of the selected typical dwelling units should have a weighted average wind velocity of 0.60 m/s. 1.2 The ventilation simulation modelling to be conducted based on the four prevailing wind directions for the building development namely North, North-East, South and South-East.	1.1 A minimum 70% of the selected typical dwelling units will be required in considering the weighted average wind velocity instead of 80%. 1.2 The ventilation simulation modelling can be conducted based on the two best prevailing wind directions for the building development that is North or North-East (N or NE) and South or South-East (S or SE).
Criteria / Requirements	**Green Mark Version NRB 4.0**	**Green Mark Version NRB 4.1**
2. AIR CONDITIONING SYSTEM SCORING AND METHODOLOGY NRB 1-2 (a) – Water Cooled Chilled-Water Plant	2.1 Scoring methodology was based on the cooling load profile for a design peak day, building operating hours specified and the chilled water plant efficiency at full load condition or part load condition	2.1 Scoring methodology was revised to consider the building cooling load profile for a typical week and building operating hours specified. The Design System Efficiency (DSE) of the proposed air-conditioning system will be based on the total average cooling load and total power inputs of the various system components. For potential Green Mark Gold^{Plus} and Platinum projects, the scoring will be based on the Design System Efficiency (DSE) derived using the energy modeling framework set out in Appendix E.

<table>
<tr><th>Criteria / Requirements</th><th>Green Mark Version NRB 4.0</th><th>Green Mark Version NRB 4.1</th></tr>
<tr><td>2. AIR CONDITIONING SYSTEM SCORING AND METHODOLOGY
Cont'd

NRB 1-2 (c) – Air Distribution System</td><td>2.2 No baseline and consideration for fan systems with power of ≤ 4kW in SS 553

2.3 The baseline standard adopted for fan system was only based on allowable motor nameplate as shown below.

<u>Baseline</u> : SS553:2009 Table 2 – Fan power limitation in air-conditioning systems

<table><tr><td colspan="2">Allowable nameplate motor power</td></tr><tr><td>Constant volume</td><td>Variable volume</td></tr><tr><td>1.7 kW/m^3/s</td><td>2.4 kW/m^3/s</td></tr></table></td><td>2.2 A baseline was established and set at 0.17 W/CMH or 0.6 kW/m^3/s

2.3 The baseline standard using fan system input power was introduced as Option 2.

<u>Option 2 – Fan System Input Power</u>

<u>Baseline</u> : ASHRAE 90.1:2010 Clause 6.5.3.1 and as prescribed below :

<table><tr><td rowspan="2">Baseline
Air Distribution System Type</td><td colspan="2">Allowable Fan System Input Power*</td></tr><tr><td>(kW/m^3/s)</td><td>(W/CMH)</td></tr><tr><td>AHUs/FCUs ≥ 4kW (Constant Volume)</td><td>1.5</td><td>0.42</td></tr><tr><td>AHUs ≥ 4kW (Variable Volume)</td><td>2.1</td><td>0.58</td></tr><tr><td>Fan systems with nameplate motor power < 4 kW</td><td>0.6</td><td>0.17</td></tr><tr><td colspan="3">* Applicable pressure drop adjustments can be considered based on ASHRAE 90.1 Table 6.5.3.1.1B and are subject to BCA's evaluation</td></tr></table></td></tr>
<tr><td>NRB 1-2 (d) – Instrumentation for Monitoring Central Water Cooled Chilled Water Plant Efficiency</td><td>2.4 No specific mention</td><td>2.4 To include the provision for dedicated power meters for each of the following groups of equipment: chillers, chilled water pumps, condenser water pumps and cooling towers under NRB 1-2(d)(vi).</td></tr>
</table>

<table>
<tr><th>Criteria / Requirements</th><th>Green Mark Version NRB 4.0</th><th>Green Mark Version NRB 4.1</th></tr>
<tr>
<td>3. MECHANICAL VENTILATION FAN SYSTEM SCORING

NRB 1-4
Mechanical Ventilation</td>
<td>The baseline standard adopted for fan system was only based on allowable motor nameplate as shown below.

<u>Baseline</u>: SS553:2009 Table 8 – Fan power limitation in mechanical ventilation systems
<table>
<tr><td colspan="2">Allowable nameplate motor power</td></tr>
<tr><td>Constant volume</td><td>Variable volume</td></tr>
<tr><td>1.7 kW/m^3/s</td><td>2.4 kW/m^3/s</td></tr>
</table>
</td>
<td>The baseline standard using fan system input power was introduced as Option 2.

<u>Option 2 – Fan System Input Power</u>

<u>Baseline</u> : ASHRAE 90.1 : 2010 Clause 6.5.3.1 and as prescribed below :
<table>
<tr><td rowspan="2">Baseline
Air Distribution System Type</td><td colspan="2">Allowable Fan System Input Power *</td></tr>
<tr><td>(kW/m^3/s)</td><td>(W/CMH)</td></tr>
<tr><td>AHUs/FCUs ≥ 4kW (Constant Volume)</td><td>1.5</td><td>0.42</td></tr>
<tr><td>Fan systems with nameplate motor power < 4 kW</td><td>0.6</td><td>0.17</td></tr>
<tr><td colspan="3">* Applicable pressure drop adjustments can be considered based on ASHRAE 90.1 Table 6.5.3.1.1B and are subject to BCA's evaluation</td></tr>
</table>
</td>
</tr>
<tr>
<td>4. ENERGY MODELLING FRAMEWORK

Under Table E3 – Baseline Standard

Item No. 2.5 –

Air-Conditioning Fan Systems</td>
<td>4.1 The baseline standard adopted for air-conditioning fan system under Table E3 was based on <u>allowable name plate motor power</u> where the ratio of fan system power to the supply fan air flow rate (main fan) of each air air-conditioning system at design conditions shall not exceed allowable fan system power stated below

Constant Volume shall not exceed 1.7 kW/m^3/s of supply air

Variable Volume shall not exceed 2.4 kW/m^3/s of supply air</td>
<td>4.1 The baseline standard adopted for air-conditioning fan system under Table E3 was based on <u>allowable fan system input power</u>.

For fan system having a motor nameplate power exceeding 4 kW, the fan power limitation in air-conditioning system that is the allowable fan system input power shall be as follows :

(i) Constant volume shall not exceed 1.5 kW/m^3/s (or 0.42 W/CMH) of supply air

(ii) Variable volume shall not exceed 2.1 kW/m^3/s (or 0.58 W/CMH) of supply air

(b) For fan system having a motor nameplate power not exceeding 4 kW, the allowable fan system input power shall not exceed 0.6 kW/m^3/s (or 0.17 W/CMH) of supply air.</td>
</tr>
</table>

<table>
<tr><th>Criteria / Requirements</th><th>Green Mark Version NRB 4.0</th><th>Green Mark Version NRB 4.1</th></tr>
<tr><td rowspan="4">4. ENERGY MODELLING FRAMEWORK
Cont’d
Item No. 2.6 –
Mechanical Ventilation Fan Systems</td><td>4.2 The ratio of fan system to the supply fan air flow rate (main fan) of each mechanical ventilation system at design conditions shall not exceed allowable fan system power.
Fan power limitation in mechanical ventilation system – Allowable nameplate motor power
(i) Constant volume shall not exceed 1.7 kW/m^3/s of supply air
(ii) Variable volume shall not exceed 2.4 kW/m^3/s of supply air</td><td>4.2 The ratio of fan system to the supply fan air flow rate (main fan) of each mechanical ventilation system at design conditions shall not exceed allowable fan system power.
Fan system design criteria
(a) For fan system having a motor nameplate power exceeding 4 kW, the fan power limitation in air-conditioning system that is the allowable fan system input power shall not exceed 1.5 kW/m^3/s (or 0.42 W/CMH) of supply air
(b) For fan system having a motor nameplate power not exceeding 4 kW, fan system input power shall not exceed 0.6 kW/m^3/s (or 0.17 W/CMH) of supply air.</td></tr>
<tr><td>Item No. 2.7 –
Lighting Systems</td><td>4.3 The baseline standard for lighting systems – SS 530 – Code of Practice for Energy Efficiency Standard for Building Services and Equipment</td><td>4.3 Lighting power budgets for common areas were specified for use. The allowable lighting power density stated in ASHRAE 90.1 can be considered if the lighting power budget for the types of usage are not made available in SS 530</td></tr>
<tr><td>New Item No. 3.7</td><td>4.3 No Provision</td><td>4.3 For projects that demonstrate considerable efforts to reduce air-conditioned space and hence greater energy savings, a cap of 2% additional energy savings over its reference model can be considered for such efforts.
Note: Provision does not apply to areas that would normally be non air-conditioned space.</td></tr>
<tr><td>Paragraph E4.5</td><td>4.4 No specific mention</td><td>4.4 The basis for deriving the overall energy consumption and potential energy savings must be made clear and justifiable for consideration. Notwithstanding this, the cap on the potential energy savings for the following systems/devices may be imposed based on the following norm :
<table><tr><th colspan="2">List of Systems/Devices</th><th>Energy savings Cap</th></tr><tr><td>Escalator</td><td></td><td>30%</td></tr><tr><td>Lifts</td><td>With VVVF and Sleep mode</td><td>10%</td></tr><tr><td></td><td>Regenerative features</td><td>18%</td></tr><tr><td>CO sensors</td><td></td><td>15%</td></tr><tr><td>Occupancy Sensors</td><td></td><td>15%</td></tr><tr><td>Photo Sensors</td><td></td><td>15%</td></tr></table></td></tr>
</table>

<table>
<tr><th>Criteria / Requirements</th><th>Green Mark Version NRB 4.0</th><th>Green Mark Version NRB 4.1</th></tr>
<tr><td>5. PRE-REQUISITE REQUIREMENT PERTAINING TO ENERGY MODELLING AND VENTILATION SIMULATION</td><td>No Provision</td><td>NEW PREQUISITE
<u>Building Developments with more than 30% Non Air-Conditioned Spaces</u>
Prerequisite requirement for building developments with a combination of ventilation mode and with aggregate non-air-conditioned spaces of more than 30% of the total constructed floor areas (excluding carparks and common areas) are as follows :
<table>
<tr><th>Aggregate Non Air-Conditioned Spaces (m^2)</th><th>Aggregate Air-Conditioned Spaces (m^2)</th><th>Ventilation Simulation Requirement</th><th>Energy Modeling Requirement</th><th>Justification on Energy Savings</th></tr>
<tr><td>≥ 2000</td><td>≥ 5000</td><td>Yes</td><td>Yes</td><td>No</td></tr>
<tr><td>< 2000</td><td>≥ 5000</td><td>No</td><td>Yes</td><td>No</td></tr>
<tr><td>≥ 2000</td><td>< 5000</td><td>Yes</td><td>No</td><td>Yes</td></tr>
<tr><td>< 2000</td><td>< 5000</td><td>No</td><td>No</td><td>Yes</td></tr>
</table></td></tr>
<tr><th>Criteria / Requirements</th><th>Green Mark Version RB 4.0 and NRB 4.0</th><th>Green Mark Version RB 4.1 and NRB 4.1</th></tr>
<tr><td>6. ENERGY EFFICIENT PRODUCTS OR EQUIPMENT
RB 1-7
NRB 1-10</td><td>No Provision</td><td>NEW CRITERIA UNDER RB 1-7 AND NRB 1-10
Use of energy efficient equipment or product that are certified by approved local certification body

Extent of Coverage : 90% of the applicable equipment type or product

0.5 point for each eligible certified equipment or products
(Up to 2 points)</td></tr>
</table>

<table>
<tr><th>Criteria / Requirements</th><th>Green Mark Version RB 4.0 and NRB 4.0</th><th>Green Mark Version RB 4.1 and NRB 4.1</th></tr>
<tr>
<td>7. SUSTAINABLE CONSTRUCTION
RB 3-1(a)(ii)
NRB 3-1(a)(ii)</td>
<td>Extent of Coverage : The total quantity used (in tonnage) for replacement of the coarse or fine aggregates must not be less than the minimum usage requirement that is [0.03 x Gross Floor Area (GFA in m^2)]

2 points for the use of RCA to replace coarse aggregates
2 points for the use of WCS to replace fine aggregates

Where the total quantity used (in tonnage) for replacement of coarse or fine aggregates is at least two times (2x) that of the minimum usage requirement.

4 points for the use of RCA
4 points for the use of WCS</td>
<td>The point scoring will be based on the quantity used (in tonnage) as illustrated below :

1 point for every incremental of 0.5 times (0.5x) of the usage requirement. (Up to 2x)

<table>
<tr><th>Quantity of RCA /WCS</th><th>Points Allocation</th></tr>
<tr><td>≥ 0.5 x usage requirement</td><td>1 point</td></tr>
<tr><td>≥ 1.0 x usage requirement</td><td>2 points</td></tr>
<tr><td>≥ 1.5 x usage requirement</td><td>3 points</td></tr>
<tr><td>≥ 2.0 x usage requirement</td><td>4 points</td></tr>
</table>

where usage requirement = 0.03 x Gross Floor Area (GFA in m^2)</td>
</tr>
<tr>
<td>8. SUSTAINABLE PRODUCTS
RB 3-2
NRB 3-2</td>
<td>The weightages given will be based on the extent of environmental friendliness as determined by the approved local certification body and are subject to BCA's evaluation were as follows.

<table>
<tr><th>Extent of Environmental Friendliness of Products</th><th>Weightage for Point Allocation</th></tr>
<tr><td>Good</td><td>1</td></tr>
<tr><td>Very Good</td><td>1.5</td></tr>
<tr><td>Excellent</td><td>2</td></tr>
</table>
</td>
<td>The weightage given for the 'Good' rating was reduced to 0.5 instead of 1 as illustrated in the following table :

<table>
<tr><th>Extent of Environmental Friendliness of Products</th><th>Weightage for Point Allocation</th></tr>
<tr><td>Good</td><td>0.5</td></tr>
<tr><td>Very Good</td><td>1.5</td></tr>
<tr><td>Excellent</td><td>2</td></tr>
</table>

Note: There is a new pre-requisite requirement for higher GM rating projects

Minimum score under RB 3-2 and NRB 3-2 Sustainable Products
Green Mark Gold^{Plus} ≥ 3 points
Green Mark Platinum ≥ 4 points</td>
</tr>
</table>

Criteria / Requirements	Green Mark Version RB 4.0 and NRB 4.0	Green Mark Version RB 4.1 and NRB 4.1
9. GREENERY PROVISION RB 3-3 NRB 3-3	No mention	EXCEPTION CLAUSE INCLUDED Trees and Palms Spacing (Centre to Centre) (a) If the selected trees and palms are to be planted at ≤ 2m from trunk-to-trunk as illustrated below, the leaf area should be calculated as the product of LAI value and planted area (in m^2). Columnar Trees (b) For trees that have tight, columnar crowns, the canopy area of 12 m^2 is to be adopted for calculation of leaf area.
10. GREEN TRANSPORT RB 3-5(c) NRB 3-5(c)	No specific mention on the extent of coverage for the provision of electric vehicle charging stations and priority parking lots within the development.	For RB 3-5(c) Extent of Coverage : Minimum 1 number of electric vehicle charging station for every 100 carpark lots (Cap at 5) 1 point For NRB 3-5(c) Extent of Coverage : Minimum 1 number of electric vehicle charging station and priority parking lot for every 100 carpark lots (Cap at 5) 1 point
11. OTHER GREEN FEATURES RB 5-1 NRB 5-1	No Provision	NEW CRITERIA UNDER RB 5-1 and NRB 5-1 1 point allocated for the computation of concrete usage index of the development
12. PRE-REQUISITE REQUIREMENT PERTAINING TO THE USE OF SUSTAINABLE PRODUCTS	No Provision	NEW PREQUISITE Minimum score under RB 3-2 and NRB 3-2 Sustainable Products Green Mark Gold^{Plus} ≥ 3 points Green Mark Platinum ≥ 4 points