

Comparison between Korean GBCC and GB Tool 2005

-on Weighting of Items-

TaeKyung Lee¹ and SangHong Lee²

¹Kyung Pook National University, DaeGu City, Korea, decon729@naver.com

² Kyung Pook National University, DaeGu City, Korea, Lsh@knu.ac.kr

ABSTRACT: This study, compared and analyzed a system of measuring of weighting of items of GBT05(Green Building Assessment Tool 2005) of Canada and GBCC (Green Building Certification Criteria) of Korea which was developed by KIER (Korea Institute of Energy Research) among the assessment criteria to assess Sustainable Buildings of Korea. The purpose of this study is to reflect more effectively weighting factors on Korean GBCC, and indicate some part of weighting factors of it which is unspecified by comparing with these two GBCCs.

Keywords: GBCC, GBTool, weight, Green Building, KGBC

1. INTRODUCTION

1.1 Background and Purpose of Study

The concept of sustainable architecture, evolved to assess pollutions from buildings and to solve the problem of exhaust of fossil fuels. GBCC(Green Building Certification Criteria) is the measure to assess Energy Efficiency, Health & Safety, Durability, Water Efficiency, Environmentally Responsiveness and Sustainable Community. Many green building councils measure environmental performance of buildings suitable for proper standards of each country's condition; Canada, USA, Japan, Korea, etc.

In 2001, GBCC was developed by KIER (Korea Institute of Energy Research) and certified by the government for its use as an measuring tool.

GBCC was used to certify commercial buildings and multi purpose houses from Jan. 2003, educational facilities from Mar. 2005.

GBCC for sales, facilities and accommodations have been developed.

This study, compared and analyzed a system of measuring of weighted items by GBT05(Green Building Assessment Tool2005) of Canada and KGBC (Korean Green Building Certification Criteria) which was developed by KIER among the assessment criteria for Sustainable Buildings of Korea. The purpose of this study is to compare more effectively weighting factors of KGBC, and indicate some weighting factors which remain unspecified by comparing with these two GBCCs.

1.2 Range and Method of Study

This study compares the differences of weights between KGBC and GBT05. KGBC has 6 GBCC's for each purpose type (apartment houses, multi purpose houses, commercial buildings, educational facilities, sales and accommodations).

2. Weights of KGBC, GBTool2005

2.1 GBT05

GBT05 was developed by iiSEB in Canada, and it can assess Pre-design, Design, Construction and Operation Phase. It has 7 issues for Site Selection, Project Planning & Development, Energy & Resource Consumption, Environmental Loadings, Indoor Environmental Quality, Functionality & Long-Term Performance and Social & Economic Aspects, and each issue has 28 categories for sub items.

System of GBT05 is split into two parts. Module A includes Benchmarks and Weights, and Fig.1 is intended to be adjusted by third parties to suit local conditions. Module B is Designed to be used by designers to carry out self-assessments within the terms established in Module A.(Figure.1)¹

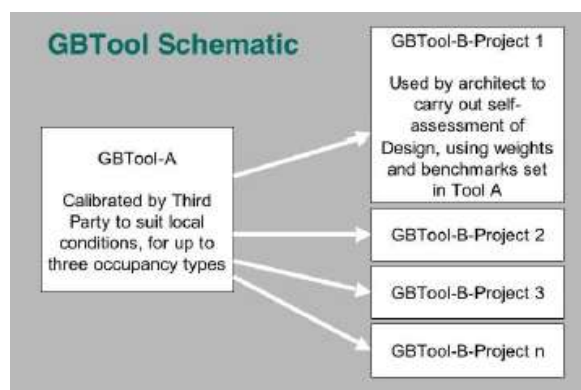


Figure 1: File Structure of A&B of GBT05

Figure 2 shows a schematic module for GBT05. And, GBT05 has Module A and Module B, and each are 9 benchmarking worksheets and 9 assessment worksheets corresponding with 9 benchmarking worksheets, respectively.

¹ GBTool notes March2005.pdf, 2p.

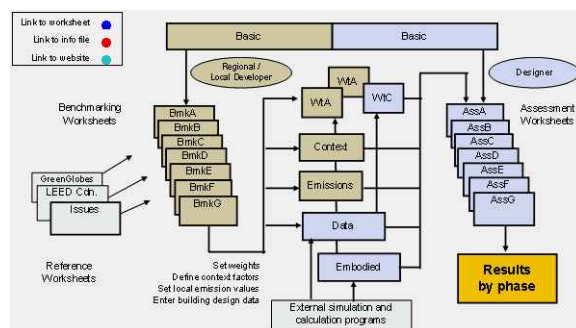


Figure 2: System Schematic-Module A&B of GBT05

2.2 KGBC

Being developed by Ministry of Environment and Ministry of Construction & Transportation of Korea, KGBC has 4 upper position items("Site and Traffic", "Energy, Resource and Operation" and "Environment" and "Indoor") and 9 sub items(Site, Traffic, Energy, Materials & Resources, Water, Atmosphere Pollution, Maintenance & Operation, Ecology and Indoor Circumstance) for 6 GBCC's for each purpose type.

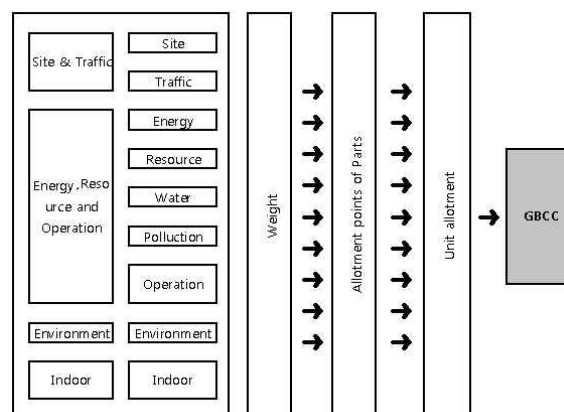


Figure 3: File Structure of KGBC²

Figure 3 shows the schematic module system for KGBC. There are about 60% of weights for 9 sub items in KGBC. And,

² Sung-min Lee, P. 2006. A Study on the Development of an Assessment Program for Green Building Certification. Vol 22. No 8. pp256. Korea.

score is recorded as total sum and value of times of points and weights.

3. Specific Comparison of Weights

In this discussion, whole characteristic of GBT05 and KGBC was analyzed first for the rule applicable to all weights, and then specific calculation for Issues, Categories and Criteria was analyzed by the use of formula.

3.1 Specific Weights of GBT05

Three calculation are included in GBT05; WTA, WTB and WTC worksheets. And there are four phases in GBT05; Pre-Design, Design, Construction and Operations. As for the assessment in WTB, each phase and Urban context for the third party are carried out using different data and produce different types of results. For the assessment in WTC, it is set automatically by GBT05, depending on specific site context factors.

Figure 4 shows the concepts of Issues, Categories and Criteria, 7 top position "Issues" column is defined as n column. Sub items, "Categories" column as m column, and last low-level weights, "Criteria" column as l column.

Total sum of Issue weighting values is called as $\sum D$, sum of category of each Issue weighting value as $\sum C$ and sum of criteria of each category weighting value as $\sum CV$.

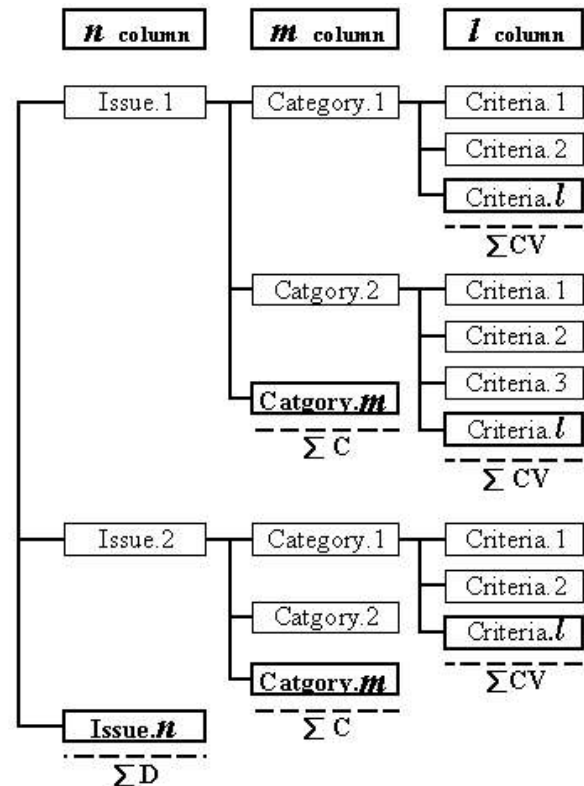


Figure 4: Concept of column of Issues, Categories and Criteria

Weighting of Issues and Categories Korea Office		English Interface	Design Phase is active
Click on blue box if you want to enter your own weights.		Using Defaults	
Value range from 0 (not applicable) to 5 (most important), with the value 2 representing the normal default or null value, except for mandatory parameters, which range from 3 to 5. Click on box at right to select Default or your own weighting values.		Suggested Default values	Active
Instructions: First decide if you want to use the defaults if you want to set your own weights 1. First set relative importance for highest level issues 2. Then set values for Categories within each Issue area 3. To set lowest level weights, go to WTB worksheet		Percent of group	Weighted percent
		Select your own weighting values.	Mandatory
Issues		Active	
A Site Selection, Project Planning and Development		3	12.5%
B Energy and Resource Consumption		5	20.8%
C Environmental Loadings		5	20.8%
D Indoor Environmental Quality		4	16.7%
E Functionality		2	8.3%
F Long-Term Performance		2	8.3%
G Social and Economic aspects		3	12.5%

Figure 5: Weight of Issues of WtA, GBT05

Issues and categories weights can be established in WtA worksheet. Figure 5 shows establishing process of Issue weights of them. If "Using defaults" is chosen on second line, red "Active" font is activating over default value. First, set relative highest level issues, then set values for Categories within each issue area. To set lowest level, criteria weights, go to WtB worksheet.

Formula (1)~(7) below is about weights how it can be established.

If 0 to 5 is given for the seven issues, it means that how much percentage each issue has, in the total issue value. Formula (1) is to calculate how much percentage the n 'th issue has among the seven issues.

$$I_n = \frac{D_n}{\sum D} \times 100(\%) \quad (1)$$

Where, Symbol: Description [Units]

I_n : weighting percent of Issues of n 'th column [%]

D_n : Issues of values of n 'th column

$\sum D$: Each issue of the sum [integer]

GBT05 is designed to adjust third party's needs to suit unique conditions applicable to certain building types in various regions. Thus, if "Using your own values" is chosen, "Active" sign in red is activated over the sky-blue part. Once score is input, the weight is calculated by the formula(2).

$$I_n = \frac{G_n}{\sum G} \times 100(\%) \quad (2)$$

Where, Symbol: Description [Units]

I_n : weighting percent of Issues of n 'th column [%]

G_n : custom Issues of values of n 'th column

$\sum G$: Each custom issue of the sum of that group

Weighting of Issues and Categories Korea Office		English Interface	Design Phase is active
Values range from 0 (not applicable) to 5 (most important), with the value 2 representing the normal default or null value, except for Mandatory parameters, which range from 3 to 5. Click on box at right to select Default or your own weighting values:		Click on blue box if you want to enter your own weights.	
Instructions: First decide if you want to use the defaults if you want to set your own weights: 1. First set relative importance for highest level Issues 2. Then set values for Categories within each Issue area 3. To set lowest level weights, go to VMB worksheet		Suggested Default values	Using Defaults
Categories (note that some categories are only operative in certain phases)		Percent of group	Weighted percent
A Site Selection, Project Planning and Development			
A1 Site Selection	4	36%	4.5%
A2 Project Planning	3	27%	3.4%
A3 Urban Design and Site Development	4	36%	4.5%
B Energy and Resource Consumption			
B1 Total Life Cycle Primary Non-Renewable Energy	5	25%	5.2%
B2 Predicted electrical peak demand for building operations	3	15%	3.1%
B3 Renewable Energy	3	15%	3.1%
B4 Commissioning of building systems	3	15%	3.1%
B5 Materials	3	15%	3.1%
B6 Potable Water	3	15%	3.1%
C Environmental Loadings			
C1 Greenhouse Gas Emissions	5	25%	5.2%
C2 Other Atmospheric Emissions	3	15%	3.1%
C3 Solid Wastes	3	15%	3.1%
C4 Rainwater, Stormwater and Wastewater	3	15%	3.1%
C5 Impacts on Site	3	15%	3.1%
C6 Other Local and Regional Impacts	3	15%	3.1%

Figure 6: Weight of Categories of WTA, GBT05

Figure 6 is a part of the weight of the items in the category of the seven topic issues. The value of "Percent of Group" in the category shows how much percent the "Weighted Percent" shares in the issue, the upper group.

It shows m 'th category value belongs in issue has a few percent of the entire.

$$PW_m = \frac{C_m}{\sum C} \times 100 \quad (3)$$

Where, Symbol: Description [Units]

PW_m : Percent of Group weight of the m 'th column category of that group Issue [%]

C_m : The weight of the m 'th category of parent group issue that category [%]

$\sum C$: Sum of category weights of that group.

$$F_m = PW_m \times I_n \quad (4)$$

Where, Symbol: Description [Units]

F_m : m 'th Weighted Category Percent of total[%]

I_n : The weight of n 'th parent group issue of that category group.

PW_m : Percent of Group weight of the m 'th column category of that group Issue[%]

Figure 7 shows Criteria weight value in WtB worksheet. The percent value of Issues and Categories is again divided by Criteria, the lowest factor. It is determined by checklist whether each item can be applicable or not and its weight value is pointed by three elements sustainable to local conditions of third parties. (global or regional = 3, urban or nbhd. = 2, building or site = 1), Intensity of potential effect (strong or direct = 3, moderate or indirect = 2, weak = 1) Duration of potential effect (>50 yr = 3, >10 yr = 2, <10 yr = 1))

$$CV_l = EP_l \times IP_l \times DP_l \quad (5)$$

Each EP, IP, and DP value is valued from 1 to 3. CV (Criteria Value) is the value of EP, IP, DP multiplied.

criteria weight within the category again.
(Formula 6)

$$CWC_l = \frac{CV_l}{\sum CV} \times 100(\%) \quad (6)$$

CWC: Criteria Weights within Category

ΣCV : Sum of criteria on the parent group category

For these reasons, even if some items of Criteria are lost, CWC except for the missing value is so scrupulously designed to be recalculated that the overall importance of each item can't be changed. Therefore, the total percentage of the CWT values is always 100 percent.

$$CWT = CWC_l \times PW_m \times I_n \quad (7)$$

CWT: Criteria weights of total system[%]

PW: Percent of Group weight of the category of m 'th column of that group Issue [%]

Low-level weights can be obtained through the above formula, and these are applied respectively to benchmark items in GBT05. It should be noted that some low-level weights are set automatically by GBT05 according to the specific contexts or features of the design in WtB worksheet. Even if some items are excluded, other important items which affect overall results

won't be changed because of formula (1)~(7).

3.2 Specific Weights of KGBC

KGBC has six certification criteria answering each purpose. In the office buildings certification criteria, weights can be applied to only 26 items among 40 total ones. There are 10 items which have unevenly spaced weights.

Each weighting value has the range from zero to the highest value of 1 which has the first decimal place. The weights which can be rewarded if a certified sustainable product is used for recycling valid resources are shown on Table 1. 4.2.2 is the subordinate part of '4. Material & Resource'.

Table I: 4.2.2 'The weights of whether to use a certified sustainable product for recycling valid resources.'

Grade	Number of using Sustainable product	Weight
1	$n \geq 9$	1.0
2	$9 > n \geq 7$	0.8
3	$7 > n \geq 5$	0.6
4	$5 > n \geq 3$	0.4
5	$3 > n \geq 1$	0.2

KGBC has the Step 1 model which determine the score by multiplying 3 and the value in 4.2.2. The sum of these values marks as a final score.

'4.2.4 Reducing materials and resources by recycling existing structures' which is the subordinate part of '4. Material & Resource' can be an example that weight distribution is not in direct proportion.

Table II: 4.2.4 'Reducing materials and resources by recycling existing structures'

Grade	Renovation [%]	Weight [decimal]
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1	$p \geq 70$	1.0
2	$70 > p \geq 50$	0.8
3	$50 > p \geq 30$	0.6

Where, Symbol: Description [Units]

p: In case of renovation total existing building in present site, the major structure reusing percent based on volumetric ratio. [%]

As seen on table 2, renovation area and weighting value are not in direct proportion. This is because recycling resources is recommended in renovating buildings. 10 items among total 40 show this type within office building certified standards.

4. Comparing the Weights of GBT05 with KGBC

4.1 Comparing Weights

The sum of weights for Issue, category and Criteria in GBT05 is 100 percent, and total sum of assessment can be scored by multiplying the combined weight of the overall each score (-1, 0, 3 and 5)

For KGBC, the highest weight of each item is 1.0, and the total score is sum of each value multiplied by the weight and score. 6 GBCC's for each purpose type (apartment houses, multi purpose houses, commercial buildings, educational facilities, sales and accommodations) has different items of GBCC. The total sum of score is different.

4.2 The Merits and Demerits of Each Weight of GBCC

The weight of GBT05 is adjusted by third parties to suit local conditions and four phases (Pre-Design, Design, Construction and Operations).

Embodied energy and emissions are included. Also addition or deletion is easy in the weighted items. This weight applies to each issue-importance, and reapply to the

category-importance and re-evaluated the lowest criteria based on the importance of the entire weights.

Therefore, even if some weighted items are added or subtracted, importance of each weight of overall is a very few change.

KGBC has 6 GBCC's for each purpose type (apartment houses, multi purpose houses, commercial buildings, educational facilities, sales and accommodations).

Buildings and the score of each item is marked by the experts at the best of the situation of Korea.

Depending on the purpose of building, however, new evaluation items were applied or existing evaluation items were disappeared.

The add-factors of KGBC are different depending on the use of a building and could lead to a total-score difference. Therefore, even though buildings of different uses have the same evaluated scores, it is irrelevant to perform qualitative comparison.

5. CONCLUSION

According to the result of comparing the weights of GBT05 with those of KGBC, even if GBCC's has different evaluation items serving the purpose, and the comparison is possible for scores of cross-certification because the importance of each weight of the entire items should be considered through formula (1) to (7).

The weighting values of each item of KGBC are not proportional. Sum of the values are different because of the different evaluation items serving the diverse purposes. The fact leads to difficulty of comparing each certification scores that weights hardly follow after the changed items serving the purposes.

Therefore the way of applying weights to each items need to be modified deliberating on this matter of playing its role in the whole part.

ACKNOWLEDGEMENT

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