

Comparison between Korean GBCC and GB Tool 2005

- on benchmark calculating method-

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ABSTRACT: To compare and analyze calculating method of benchmarks GBT05 (Green Building Assessment Tool 2005) of Canada and KGBC (Green Building Certification Criteria of Korea) which was developed by KIER (Korea Institute of Energy Research) as an assessment criteria to assess Sustainable Buildings of Korea. The purpose of this study is to analyze and compare with scoring methods of benchmark of criteria of these two GBCCs, and to complement and establish well-grounded objective benchmark for the factors without either statistical data or legal explicit statement.

Keywords: GBCC, GBTool, benchmark, 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 of expanded ideas about 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.

It was compared and analyzed on calculating method of benchmarks of GBT05 (Green Building Assessment Tool 2005) of Canada and KGBC (Green

Building Certification Criteria of Korea) which was developed by KIER (Korea Institute of Energy Research). The purpose of this study is to analyze and compare with scoring methods of benchmark of criteria of these two GBCCs, and to complement and establish well-grounded objective benchmark for the factors without either statistical data or legal explicit statement.

1.2 Range and Method of The Study

On this study, differences between KGBC and GBT05 on Benchmark are compared and analyzed. And its purpose is to develop upgraded certifying program for KGBC.

2. Benchmarks of KGBC and GBT05

On the second chapter, broad characteristic of benchmarks of KGBC and GBT05 are compared, and the specific parts of benchmarks are on the third chapter; method of calculation.

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

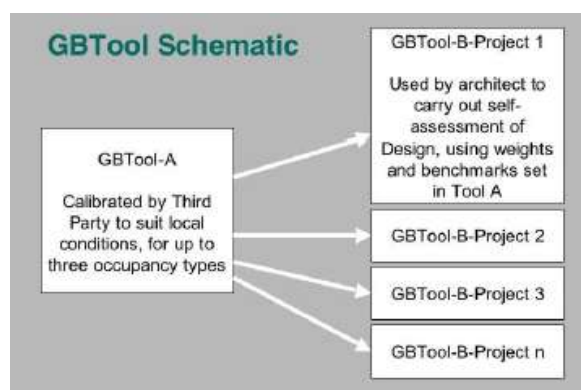


Figure 1: File Structure of A&B of GBT05

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 2 shows the schematic module system for KGBC.

The weights are in the lowest level of items which corresponds with Benchmark in KGBC, and Scores of all items are various. And it is the value which already applied weights, the importance of whole, established by experts, but the standard is not clear.

Score times second weight is detailed assessment in GBT05, and the total makes final certifying score.

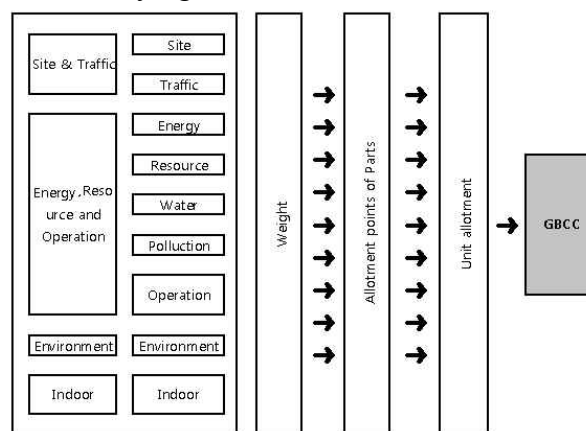


Figure 2: File Structure of KGBC²

3. Specific Comparison of Benchmark

In this discussion, whole characteristic of GBT05 was analyzed first for the calculation method applicable to all benchmarks, and specific calculation for benchmark was analyzed by the use of formula, and then scoring method of KGBC was compared and analyzed on specific differences.

3.1 Specific Benchmark of GBT05

The Benchmark worksheet is designed to allow the entry of benchmark performance

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.

¹ GBTool notes March2005.pdf, 2p.

values that are appropriate to the region and occupancy types included in the building. The intent of the benchmarks is to provide a meaningful basis to assess performance values of the case-study project. In defining appropriate benchmark;

*Quantifiable issues (energy use, water use etc.) are assumed to be either minimum code requirements or typical practice, depending on access to reliable data. In either case there must be a clear description and rationale of the choice.

*For many of the qualitative criteria considerable judgement will be required. The default benchmarks for these are simply a declaration of what would be considered to be a typical condition or typical practice for the building type in the region. These are entered in the yellow comment boxes and these are calculated by the sub-group carrying out the scoring.

Benchmarks in GBT05 are the basis for assigning scores for performance of the case-study projects, so they are of considerable importance;

*They should be equivalent to the minimum acceptable industry practice in the region, for this type and class of building. In many cases, there may be a regulation that is applicable, but in other cases the assessment team must make a determination based on local industry practices. This may require assembling a panel of regional experts.

*Some of these benchmarks are context dependent.

The Benchmark worksheet groups the information into the following categories;

*General building design benchmarks

*Benchmarks for Materials, including a simple method for approximating the benchmark initial embodied energy of the building structure.

*Embodied Energy Benchmarks

*General Benchmarks by Occupancy Type

*Benchmarks for Natural Ventilation Systems

*Benchmarks for Mechanical Systems

*Benchmarks for Refrigerants in Mechanical Systems

*Benchmarks for mechanical Ventilation Systems by Occupancy Type

*Occupant Density and Water Consumption Benchmarks for Residential occupancies³

Benchmarks are of two basic types; those that can be expressed as numeric values, and others that are best described in text form.

In the GBT05 system tried to express as many parameters as possible in a numeric form, but in some cases this would provide spurious results. In all cases, performance values are related to a scale that ranges from -1 to +5, with interpretation as follows.

Where, Symbol; Description

-1: Negative

0: Minimum acceptable performance (usually but not always defined by regulation)

3: Good practice

5: Best practice

Naturally, the performance levels tied to each score will vary by location and often by building type, which is why GBT05 requires local third parties to define appropriate performance levels. In the case of numeric parameters, this is done by setting two numeric values at the 0 to +5 levels (see Figure 3), which then defines the slope of a line that automatically sets the values for the -1 and +3 performance levels.⁴

A1.3 Selection of land vulnerable to flooding.			
Intend	To discourage the selection of land for building where there is a substantial risk that the site may be flooded.	Applicable phases (Active if green)	
Indicator	Height above 100-year flood plain as defined in official documentation or assessment by competent authorities.	P-Dsn.	
Information sources and notes	Reference A, B and C.		
Applicability	Total building, all sizes.		
	Total Project	m	Score
Negative		1.0	-1
Acceptable practice		1.3	0
Good Practice	The height of the minimum elevation of the site above the elevation of the 100-year flood plain is:	2.0	3
Best Practice		2.5	5

Figure 3: Typical Benchmark statement

³ GBC2k2 Manual, 17p.

⁴ GBT001 notes March 2005, 6-7p.

for a numeric-based parameter, showing two yellow cells for entry of local values.

Additionally speaking, Figure 3 is an example of benchmark, 'selection of land vulnerable to flooding'. To discourage the selection of land for building where there is a substantial risk that the site may be flooded, set the benchmark of the minimum height of the site above the elevation of the 100-year flood plain.

$$H = a - \frac{3}{5}(a - b) \quad (1)$$

Where, Symbol; Description

H: The value applicable to numeric+3

a: The value applicable to numeric +5

b: The value applicable to numeric 0

Figure 4 is enlarged part of yellow cells of Figure 3. Parameters, in the Figure 7, are the values applicable to numeric; 0 and +5. The values of numeric -1 and +3 are determined by two parameters corresponding to 0 and +5. The value of numeric +3 is automatically calculated by formula 1. In other words, if the height above 100-year flood plain as defined in official documentation or assessment by competent authorities is between 1m and 1.3m, (then) score 0 point, and is over 2.5m, (then) score 5 point.

As the parameters 2.5m and 1.3m are read in yellow cells, the benchmark value 1m and 2m which corresponding to -1 and +3 are established automatically.

	m	Score
the site above the elevation of the 100-year flood plain is :	1.0	-1
	1.3	0
	2.0	3
	2.5	5

Figure 4: Figure1, enlarged for yellow cell part .

Formula (1) defines the slope of a line that sets the values for the -1 and +3 performance levels of benchmark in GBT05, and came from formula (2), the initial type.

$$(b-H):(H-a)=2:3 \quad (2)$$

Formula (3) came from formula (2) by aligning the value of H. Formula (1) is achieved with simplification suitable to the characteristic of program.

$$H = \frac{2a+3b}{5} \quad (3)$$

Like formula (1), the formula (4) automatically determines a value equivalent to -1.0, which is called L that is automatically calculated through formula (4) entering a variable in yellow cells.

$$L = a - \frac{(a-b)}{5} \quad (4)$$

Where, Symbol; Description

L: The value applicable to numeric -1

a: The value applicable to numeric +5

b: The value applicable to numeric 0

This formula is determined by the proportion of each value. Initial type of formula 5 came from analyzed formula (4).

$$(L-a):(b-a)=1:5 \quad (5)$$

The procedure for defining appropriate performance levels for text-based parameters consist of defining performance condition that appear to be appropriate for each performance score. In GBT05 provided some suggested default statements, but third parties can revise this to suit local conditions. All benchmarks defined by third parties in Module A are automatically copied to Module B, for use by Designers (see Figure5). Some values of text based

input do not affect the outcome but require to fill in specific details such as floor height of the building or net area in the assessment part. To make program simpler, these text-based parameters would rather go to Basic A Sheet, the initial information part than to Benchmark because GBT05 has too many parameters and complicated tree structures.

D2 Ventilation			
D2.1 Design features to maximize effectiveness of ventilation in naturally ventilated occupancies			
Intent	To ensure that the number, placement and type of windows or other openings in a naturally-ventilated building are capable of providing a high level of air quality and ventilation.		Applicable phases (Active if green)
Indicator	Area and location of windows that provide natural ventilation.		Dsn Ops.
Information sources and notes	Cross-ventilation is defined as spaces where operable windows are located on at least two separate walls.		
Applicability	Total Building, all sizes, under user-defined height limit.		
	Height limit, floors	20	Score
Negative	The aggregate area of openings from primary occupancy areas to the exterior is less than 5% of the aggregate primary floor area, and less than 50% of all primary spaces have cross-ventilation.		-1
Acceptable practice	The aggregate area of openings from primary occupancy areas to the exterior is at least 5% of the aggregate primary floor area, and more than 50% of all primary spaces have cross-ventilation.		0
Good Practice	The aggregate area of openings from primary occupancy areas to the exterior is at least 5% of the aggregate primary floor area, and at more than 75% of all primary spaces have cross-ventilation.		3
Best Practice	The aggregate area of openings from primary occupancy areas to the exterior is at least 10% of the aggregate primary floor area, and more than 90% of all primary spaces have cross-ventilation.		5

Figure 5: Typical Benchmark statement for a text-based parameter.

Benchmarks are set to be established by 2 type maximum on a multi-unit residential building. Figure 6 and 7 below show benchmark certifying items changed depending on different types of building; a single-unit residential building and a multi-unit residential building.

D4 Daylighting and Illumination			
D4.1 Design features to ensure acceptable daylighting in primary occupancy areas			
Intent	To ensure an adequate level of daylighting in all primary occupied spaces.		Applicable phases (Active if green)
Indicator	The predicted Daylight Factor in a typical occupancy area located on the ground floor of the building, as indicated by drawings and specifications.		Dsn Ops.
Information sources and notes			
Applicability	For each occupancy, all sizes.		
	Office	DF	Score
Negative		1.3%	-1
Acceptable practice		1.5%	0
Good Practice		2.1%	3
Best Practice		2.5%	5
	University	DF	Score
Negative		0.9%	-1
Acceptable practice		1.0%	0
Good Practice		1.3%	3
Best Practice		1.5%	5

Figure 6: Daylighting and Illumination Benchmark for 1 purpose type.

D4 Daylighting and Illumination			
D4.1 Design features to ensure acceptable daylighting in primary occupancy areas			
Intent	To ensure an adequate level of daylighting in all primary occupied spaces.		Applicable phases (Active if green)
Indicator	The predicted Daylight Factor in a typical occupancy area located on the ground floor of the building, as indicated by drawings and specifications.		Dsn Ops.
Information sources and notes			
Applicability	For each occupancy, all sizes.		
	Office	DF	Score
Negative		1.3%	-1
Acceptable practice		1.5%	0
Good Practice		2.1%	3
Best Practice		2.5%	5
	University	DF	Score
Negative		0.9%	-1
Acceptable practice		1.0%	0
Good Practice		1.3%	3
Best Practice		1.5%	5

Figure 7: Daylighting and Illumination Benchmark for multi purpose type.

Figure 7 is an example of benchmark of a multi-unit residential building. "Yes" on Basic A sheet is selected for a multi-unit residential building part, and each type of a building goes to 'other occupancy 1 and 2' part and then, the Benchmark is formulated which suits the purposes of two types of buildings.

Values relevant to all of four yellow cells are applied to a multi-unit residential building. Two of them are operated on a single-unit residential only and the others serving the purpose except residence are done on a multi house.

3.2 Specific benchmark of KGBC

KGBC has six certification criteria answering for six purposes. These criteria have similar scores in most of the same criteria, but different scores in some cases.

There are 34 weights among the total 41 parts, looking through certification scores for residential parts of KGBC's multi purpose building. KGBC has various and un-unified scores. Weights seem to be applied in advance by experts according to the specific circumstances of construction in Korea. These scores range from 1 to 12. (See table I)

Table I: For residential score and benchmark type among multi-purpose KGBC

No	Score	bench- mark	Addition Item
	[Point]	[Type]	
1	1.1.1	2	A
	1.2.1	3	F
	1.3.1	2	A
2	2.1.1	2	A
	2.1.2	1	A
	2.1.3	2	A
3	3.1.1	12	F
	3.2.1	2	A
4	4.1.1	2	A
	4.1.2	3	B
	4.2.1	2	A
	4.3.1	3	B
	4.3.2	3	A
	4.4.1	3	A
	4.4.2	2	B
	4.4.3	7	A
	4.4.4	2	A
5	5.1.1	3	A
	5.2.1	4	C
	5.2.2	3	F
	5.2.3	4	F
6	6.1.1	3	B
	6.1.2	3	C
7	7.1.1	2	C
	7.2.1	3	B
	7.3.1	4	A
8	8.1.1	6	D
	8.1.2	7	E
	8.2.1	3	E
	8.2.2	3	E
9	9.1.1	6	D
	9.1.2	1	B
	9.1.3	2	D
	9.1.4	1	F
	9.2.1	2	A
	9.3.1	4	E
	9.3.2	2	E
	9.3.3	2	A
	9.3.4	2	A
	9.4.1	2	A
	9.5.1	1	F

This has the merit that high scored items are adopted preferentially depending on the importance determined by the score which an item marks. In other words, a higher score means a higher weight and it is easy to get a good grade on certifying process. Consequently, client might meet the highest scores ahead and offer an opportunity to get a good grade.

There are 6 type of benchmark, included in certification criteria, not separated from criteria.

Where; Symbol: Description

A type: Directly proportional weight

B type: Jagged proportional linear weight

C type: Sum of more than 2 scores calculated from weight

D type: Sum of each score

E type: Scoring by etc. formula

F type: type of non weight

4. Comparison Benchmark between GBT05 and KGBC

Benchmark of GBT05 has 4 scoring standards; -1, 0, +3 and +5. Benchmark multiplying weights by three stages becomes assessment, the sum of which is +5, a full mark.

Benchmark on KGBC has the fixed score, which can not be chosen. However, the sum of value multiplying weight by one stage can be calculated. The final scores of certification criteria for six purposes are all different. The total score of apartment house is 136, residential house 128, un-residential 115 and the score of multi purpose houses is decided by formula (6).

Total score of commercial building is 136, accommodations 133, educational 124 and sales 119.

$$T = \frac{S_a \times N_a + (.x+y) \times N_b}{\sum N} \quad (6)$$

Where, Symbol; Description [Unit]

T: Total sum of score of multi purpose building

Sa: Sum of score of residential part

Na: Sum of net area of residential part

x: Percent of score of non residential part

y: Sum of additional item of non residential part

Nb: Sum of net area of non residential part

$\sum N$: Total net area

As above, total scores of them are various and even in the same criteria, each score is not equal.

5. CONCLUSION

In the case of GBT05, all criteria have a consistent benchmark score. The weight is calculated by the importance determined by the value of the criteria, so the total scores of each different kind of building can be compared.

In KGBC, however, scores of all criteria are various and certification standard is not unified yet. In addition to weights adjusted in advance by experts, the reasons for different scores of all items are not clearly presented.

The first phase multiplies weights by a single value already determined by experts. This formulated figure becomes assessment. The sum of assessment is a final score.

Assessment criteria do not necessarily correspondent particularly and the scores are not consistent but various. The final score is hard to compare with scores of different purpose buildings. Therefore, the values in KGBC need to be decided within a fixed range of values and the integration which can allow weights to apply to the total criteria need to be newly established.

Type A and B need to be reestablished for numerical proper proportion.

Type C and D need to be properly formulated for their specific circumstances during benchmark process.

Type E had better be separated from benchmark and established new rules by creating a yes/no checking box.

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ACKNOWLEDGEMENT