

Comparison and Analysis of Domestic and Foreign Green Building Certification Criteria Through Case Study of Green Building

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ABSTRACT: Green Building Certification Criteria of foreign country have began to introduce in our country since 2000 and Green Building Certification Criteria carried out in 2002 and have constantly made up since then. This criteria applied to an apartment house, a complex residence and a building for business in January, 2002 and included a school in March, 2005 and expanded to a sales facility and a lodging facility in september, 2006. But according to the result came from the comparison which certified building in our country compared with items of valuation presented from foreign certification criteria, the result of certification or classification about a building are different each other. The reason that the result of valuation is so different is that the item of large classification and the item of small classification are different and the ratio of evaluation and weight are different about the item which is similar in contents. Therefore in this research, we select a building which certified form our country as a case and evaluate a environmental ability of each building with both Domestic Green Building Certification and LEED(Leadership in Energy & Environmental Design) Green Building System made by USGBC(United States Green Building Council), and have a comparative analysis about the character of each criteria came from the result of valuation and the different of certification method.

Keywords: Green Building Certification Criteria, LEED(Leadership in Energy & Environmental Design) Green Building System, USGBC(United States Green Building Council)

1. INTRODUCTION

After the 18th Century industrial revolution, main energy source changed to fossil fuels through mass consumption and mass production process. However, as a lot of fossil fuels began to be used, carbon dioxide emission rapidly increased and global warming was proceeded rapidly

throughout the world. Countries that have realized the problem that climate change in the future will cause abrupt changes in human society began to set plans for climate change through scientific investigations and numerous conferences. Among the plans, United Nations Framework Convention on Climate Change, 1997 as the beginning, advanced countries' regulation on Green-

house gas problem becomes reinforced and Korea also is forced to participate in the reduction of Green-house gas. Currently, in construction field, environment-related certification system is executed, and criteria s for the environmental function of building such as BREENAM in 1991 as beginning, Canada's BEPAC, the U.S. LEED and Japan's Environment Coexistence Houses, etc. have been enacted and Korea also executes Green Building Certification Criteria from 2002 as joining World Climate Convention.

But according to the result came from the comparison which certified building in our country compared with items of valuation presented from foreign certification criteria, the result of certification or classification about a building are different each other. The reason that the result of valuation is so different is that the item of large classification and the item of small classification are different and the ratio of evaluation and weight are different about the item which is similar in contents. Therefore in this research, we select a building which certified form our country as a case and evaluate a environmental ability of each building with both Domestic Green Building Certification and LEED(Leadership in Energy & Environmental Design) Green Building System made by USGBC(United States Green Building Council), and have a comparative analysis about the character of each criteria came from the result of valuation and the different of certification method..

1.2 The Method and Procedure of Research

This study tries to compare and analyze the sale facilities that acquired an excellent grade in preliminary certification for domestic environment-friendly building with the U.S LEED 2.2 Criteria. method of comparison and analysis are as follows:

1) Assessment of case building by GBCC

- 2) Assessment of GBCC certified case building by LEED Criteria
- 3) Comparison and analysis the assessment items and methods of GBCC and LEED
- 4) The problems and improvement direction of domestic environment-friendly building certification system.

2. The Cases of the certification of Domestic Environment-Friendly Building

2.1 Overview of Case Building

The case of S department store that acquired an excellent grade in preliminary certification for domestic environment-friendly building was assessed by certification criteria of the use of sale facility for the first time.

Table I : Overview of Case Building

Site	Busan
Plottage	40,711.50 m ² (12,315.23py)
Building Area	20,353.60 m ² (6,156.96py)
Total Floor Area	294,853.11 m ² (89,193.37py)
Greens Area	15.13%
Building-to-land ratio	49.99%
Floor space index	342.30%
Floors	B5 floors, 14 floors
Parking	2,644 (cars)

2.2 The Result of Assessment by GBCC

Table II is the allocation of points for the assessment items of preliminary certification and acquired points at the time of acquisition. The case building acquired 67.99 out of total 119 points and got an 'excellent' grade. Examining acquired point details for each section in Table II, maintenance section was 24.5, ecology/environment section was 11.31, and energy section, 7.36 in order. To look into

the ratio of acquired points, maintenance section 100%, air pollution section 90%,

Table II : comparison with common items of LEED2.2 with GBCC Criteria

Section	GBCC Criteria		Full marks	Acquired points	LEED2.2 Criteria
1.Site Use	1.1.1	the ecological value of existing lot	2	2	SS. Credit 1. Site Selection
	1.2.1	building coverage	3	0.003	—
2. Transportation	2.1.1	the proximity to public transportation	2	2	SS. Credit 4.1 Alternative Transportation (Public Transportation Access)
	2.1.2	whether bicycle depository is installed	1	0	SS. Credit 4.2 Alternative Transportation (Bicycle Storage & Changing Rooms)
3. Energy	3.1.1	energy consumption assessment	15	10.74	EA. Credit 1. Optimize Energy Performance
	3.2.1	the use of new and recycled energy	4	1.2	EA. Credit 2 On-Site Renewable Energy
	3.2.2	whether natural ventilation design in parking space is employed	5	0	—
4. Material and Resource	4.1.1	the application of industrialized method of construction and new environmental technology	3	3	—
	4.1.2	the saving of consumption materials used in restroom	1	1	—
	4.2.1	whether for environment-friendly certified products for the recycling of efficient resources is used	3	2.4	MR.. Credit 3.1, 3.2 Materials Reuse
	4.2.2	the separate collection of recyclable resources	3	3	—
	4.2.3	the saving of materials and resources through the reuse of existing construct	7	0	MR.. Credit 1.1, 1.2 Building Reuse
	4.2.4	the saving of materials and resources through the reuse of existing construct	2	0	MR.. Credit 1.3 Building Reuse
	4.2.5	the reduction of food refuse	1	0.5	—
5. Water Resources	5.1.1	the validity of reducing measure of rain water load	3	0	—
	5.2.1	the validity of reducing measure of water supply	4	3	—
	5.2.2	the use of rain water	3	0	WE. Credit 1.2 Water Efficient Landscaping
	5.2.3	grey water installation	4	4	WE. Credit 2. Innovative Wastewater Technologies
6. Air Pollution	6.1.1	the reduction of carbon dioxide emission	3	3	—
	6.1.2	the prohibition of the use of specific material for Ozone layer protection	3	2	EA. Credit 4 Enhanced Refrigerant Management
7. Maintenance	7.1.1	rationality of site management plan considering environment	2	2	—
	7.2.1	operation / the validity of the provision of maintenance document and guideline	4	4	—
	7.2.2	the validity of commissioning work measure	2	2	EA. Credit 3. Enhanced Commissioning
8. Ecology Environment	8.1.1	whether the afforestation technique of artificial environment considering ecological environment is applied	2	0	—

	8.1.2	landscape architecture area factor	3	1	—
	8.2.1	the creation of aquatic bio-top	3	0	—
	8.2.2	the creation of terrestrial bio-top	2	0	—
9. Indoor Environment	9.1.1	the use of material containing low toxic substances	6	3.15	EQ. Credit 4.1,4.2 Low-Emitting Materials
	9.1.2	the design of external supply-return vent slots	3	3	EQ. Credit 2 Increased Ventilation
	9.1.3	the control of other toxic substances from construction materials	1	1	—
	9.1.4	the construction of CO ₂ monitoring system and the assessment of ventilation volume	6	6	EQ. Credit 1 Outdoor Air Delivery Monitoring
	9.2.1	whether automatic indoor temperature controlling device is employed	2	0	—
	9.3.1	the provision of space to rest and recharge	6	6	—
	9.4.1	the improvement of sanitation in-building water pipes	1	0	—
	9.5.1	validity of care for the old, the weak and the handicapped	2	2	—

indoor environment section 78.33%, which it acquired full marks in maintenance section and total assessment score rate is 57.13%, which is shown in Table III and Figure 1. If you look at Figure 2, GBCC assessment criteria allot great points to indoor environment, energy, material and resource.

Table III : acquired point ratio for each GBCC section

Section	Ratio(%)
Site Use	40.06%
Transportation	66.66%
Energy	49.75%
Material and Resource	49.5%
Water Resources	30%
Air Pollution	90%
Maintenance	100%
Ecology Environment	10%
Indoor Environment	78.33%
Total	57.13%

3. LEED Green Building System

LEED Green Building System that the U.S. USGBC executes developed LEED Version 1.0 in 1998. After that, it has been revised in every 3 years and 2006 LEED Version 2.2,

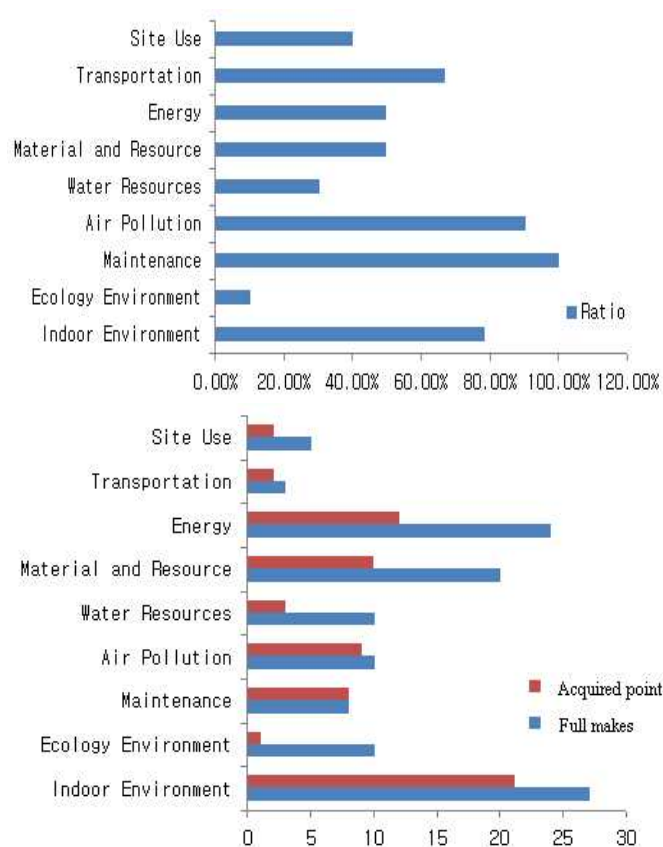


Figure 1: Acquired point ratio for each GBCC section

the latest revision consists of 6 big classification items(Sustainable Sites, Water efficiency, Energy & Atmosphere, Materials

& Resources, Indoor Air Quality, Innovation & Design Process) and 58 general assessment items and presents 7 prerequisites which must be basically satisfied for each item. It is divided into 4 certification grades of Certified, Silver, Gold and Platinum.

3.1 The Assessment of the Case Building by LEED 2.2 Criteria

As the method of assessment, as you can see in TableIV, to the items belonged to GBCC is given points that are not related to GBCC was excluded, marking 0point.

As a result of the assessment by LEED 2.2 Criteria, it acquired 26 points out of 69 points. This belongs to certified grade, and the lowest grade among LEED2.2 certification criteria. However, exclusion of items not belonged to GBCC as 0 point should be considered.

LEED 2.2 takes Energy and Atmosphere section the most point distribution and points are allocated in the order of Indoor Environmental Quality, Sustainable Sites, Material and Resources, Water Efficiency.

To examine the result of assessment for each section, acquired points were 3 points in Sustainable Sites section, 2 points in Water Efficiency section, 10 points in Energy and Atmosphere section, 2 points in Material and Resources section, 5 points in Indoor Environmental Quality section, and 4 points in Innovation and Design Process section, an additional item and the ratio of acquired point to total point were 58.82% in Energy and Atmosphere section, 40% in Water Efficiency section, 33.33% in Indoor Environmental Quality section, 21.43% in Sustainable Sites and 15.38% in Material and Resources, the lowest rate. Material and Resources and Indoor Environmental Quality sections and Sustainable Site turned out to be low because, they have low importance for the total point though they have high point distribution for assessment section.

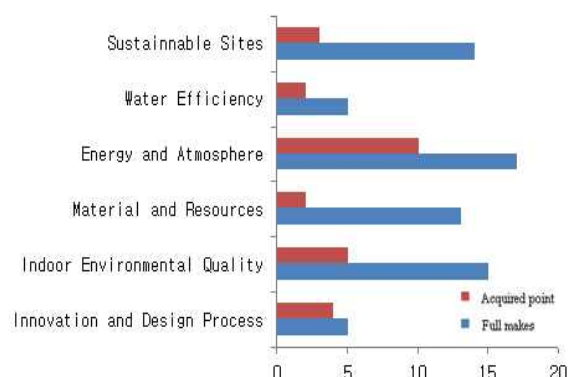


Figure 2: Acquired point for LEED 2.2

4. The Comparison and Analysis of Foreign and Domestic Assessment Items and Methods.

The reason why the result of assessment is different is that the classification and detailed items and point allocation criteria of domestic certification criteria is different from those of LEED and the certification grades were different from each other because the items that are not corresponding to GBCC criteria was allotted 0 point.

4.1 The Comparison of the Systems of Assessment Items

As a result of comparison of assessment items of the two certification system of GBCC and LEED, the common items belonging to both certification system are first, items like the proximity to public transportation in transportation section and the installation of bicycle depository. Second, in energy section, LEED allows to get provided part of electricity to building using recycled energy and GBCC also grants points according to whether new or recycled energy is installed and Third, in Material and Resources section, both have items about the recycling of resources, such as the reuse of existing wall, floor, roof and materials in common. Fourth, in Water Resources section, assessment items of water saving, rain water using, and

Table IV : The Assessment of the Case Building by LEED 2.2 Criteria

Assessment Items		Full Marks	GBCC Assessment
Sustainable Sites (14points)			
Prereq 1	Construction Activity Pollution prevention	Required	
Credit 1	Site Selection	1	1
Credit 2	Development Density & Community Connectivity	1	1
Credit 3	Brownfield Redevelopment	1	0
Credit 4.1	Alternative Transportation, Public Transportation Access	1	1
Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Rooms	1	0
Credit 4.3	Alternative Transportation, Low-Emitting and Fuel-Efficient Vehicles	1	0
Credit 4.4	Alternative Transportation, Parking Capacity	1	0
Credit 5.1	Site Development, Protect of Restore Habitat	1	0
Credit 5.2	Site Development, Maximize Open Space	1	0
Credit 6.1	Stormwater Design, Quantity Control	1	0
Credit 6.2	Stormwater Design, Quality Control	1	0
Credit 7.1	Heat Island Effect, Non-Roof	1	0
Credit 7.2	Heat Island Effect, Roof	1	0
Credit 8	Light Pollution Reduction	1	0
Water efficiency (5points)			
Credit 1.1	Water Efficient Landscaping, Reduce by 50%	1	0
Credit 1.2	Water Efficient Landscaping, No Potable Use of No Irrigation	1	1
Credit 2	Innovative Wastewater Technologies	1	1
Credit 3.1	Water Use Reduction, 20% Reduction	1	0
Credit 3.2	Water Use Reduction, 20% Reduction	1	0
Energy & Atmosphere (17points)			
Prereq 1	Fundamental Commissioning of the Building Energy Systems	Required	
Prereq 1	Minimum Energy Performance	Required	
Prereq 1	Fundamental Refrigerant Management	Required	
Credit 1	Optimize Energy Performance	1 to 10	8
Credit 2	On-Site Renewable Energy	1 to 3	0
Credit 3	Enhanced Commissioning	1	1
Credit 4	Enhanced Refrigerant Management	1	1
Credit 5	Measurement & Verification	1	0
Credit 6	Green Power	1	0
Materials & Resources (13points)			
Prereq 1	Storage & Collection of Recyclables	Required	
Credit 1.1	Building Reuse, Maintain 75% of Existing Walls, Floors & Roof	1	0
Credit 1.2	Building Reuse, Maintain 100% of Existing Walls, Floors & Roof	1	0
Credit 1.3	Building Reuse, Maintain 50% of Interior Non-Structural Elements	1	0
Credit 2.1	Construction Waste Management, Divert 50% from Disposal	1	0
Credit 2.2	Construction Waste Management, Divert 70% from Disposal	1	0
Credit 3.1	Materials Reuse, 5%	1	1
Credit 3.2	Materials Reuse, 10%	1	1
Credit 4.1	Recycled Content, 10% (post-consumer + 1/2 pre-consumer)	1	0
Credit 4.2	Recycled Content, 20% (post-consumer + 1/2 pre-consumer)	1	0
Credit 5.1	Regional Materials, 10% Extracted, Processed & Manufactured Regio	1	0
Credit 5.2	Regional Materials, 20% Extracted, Processed & Manufactured Regio	1	0
Credit 6	Rapidly Renewable Materials	1	0
Credit 7	Certified Wood	1	0
Indoor Environmental Quality (15points)			
Prereq 1	Minimum IAQ Performance	Required	
Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required	
Credit 1	Outdoor Air Delivery Monitoring	1	1
Credit 2	Increased Ventilation	1	1
Credit 3.1	Construction IAQ Management Plan, During Construction	1	0
Credit 3.2	Construction IAQ Management Plan, Before Occupancy	1	1
Credit 4.1	Low-Emitting Materials, Adhesives & Sealants	1	1
Credit 4.2	Low-Emitting Materials, Paints & Coatings	1	1
Credit 4.3	Low-Emitting Materials, Carpet Systems	1	0
Credit 4.4	Low-Emitting Materials, Composite Wood & Agrifiber Products	1	0
Credit 5	Indoor Chemical & Pollutant Source Control	1	0

Credit 6.1	Controllability of Systems, Lighting	1	0
Credit 6.2	Controllability of Systems, Thermal Comfort	1	0
Credit 7.1	Thermal Comfort, Design	1	0
Credit 7.2	Thermal Comfort, Verification	1	0
Credit 8.1	Daylight & Views, Daylight 75% of Spaces	1	0
Credit 8.2	Daylight & Views, Daylight 90% of Spaces	1	0
Innovation & Design Process (5points)			
Credit 1.1	Innovation in Design, Provide Specific Title	1	1
Credit 1.2	Innovation in Design, Provide Specific Title	1	1
Credit 1.3	Innovation in Design, Provide Specific Title	1	1
Credit 1.4	Innovation in Design, Provide Specific Title	1	1
Credit 2	LEED Accredited Professional	1	0
Project Totals (pre-certification estimates)		69point	26point

deuterium oxide process of used water are subdivided respectively. Fifth, in Air Pollution section, as detailed item of Ozone layer protection, the use of materials affecting global warming are restricted, and in the case of GBCC, in Ozone layer protection item, assess whether CFC and Halon are included in fire extinguisher, heat design for reducing heat island, the prevention of light polluting materials, all of which are not considered in Korea. Other than classification items, additionally assessed items, LEED certified architects' participation in design was given points. Items belonging exclusively to GBCC grants points to criteria like the assessment of hand method after washing hands, consumption material, used in restroom, the installation of separate collection for food refuse, landscape architecture are factor, the creation of rest space and the design for the old, the weak and the handicapped, etc. The domestic and foreign certification criteria show differences because they reflect residential culture of the country to which the two certification system belong such as the items and allocation of points with different methods of assessment and items belonging to the classification system, etc. though they have the same classification system.

4.2 The Comparison of Assessment Grade System

The GBCC calculates multiplying the weight by criteria for each item while LEED is a way in which one must follow

insulator and refrigerant. Lastly, in Indoor Environment section, items like the use of material emitting low VOC, the creation of fresh indoor environment are included in common. Items that only LEED2.2 criteria includes are the ones of the use of certified lumber and local resources, item for assessing landscape architecture or exterior Items belonging exclusively to GBCC grants points to criteria like the assessment of hand drying method after washing hands, consumption material, used in restroom, the installation of separate collection for food refuse, landscape architecture area factor, prerequisites that each item suggests basically and can acquire 1 point when it satisfied them.

In LEED one can acquire the highest point in Energy and Atmosphere item, and for the detailed item, in the use of item, Optimize Energy Performance, one can get 1~10 points out of total 17points. In GBCC, Indoor Environment section has 27 points, the most out of 119 and the use of material containing low noxious substances, the construction of CO₂ monitoring system and the assessment of ventilation volume and space to rest and recharge have 6 point, which is high.

5. CONCLUSION

The following conclusion came out from assessing the domestic case building using the domestic Environment-Friendly Construction Certification Criteria and the U. S. LEED and comparing and analyzing the result. As a result of the assessment of the

case building, 67.99 points(57.13%) by GBCC and 26 points(37.68 %) by LEED was shown as ratio of acquired point to total point and there was difference in the final certification grade. This seems to be cause by the reflection of each country's characteristics to the certification system. The items of common inclusion in the criteria of the two certification systems were the proximity to public transportation and the installation of bicycle depository in Transportation section, the items of the use of recycled material, in Materials and Resources section, the saving of water, the reduction of rainwater load in Water Resources section, the use of alternative energy in Energy section, the item for Ozone layer protection in Air Pollution, the use of material emitting low VOC and the creation of fresh indoor environment in Indoor Environment section, were in common assessment items for environment-friendly building that are applied regardless of the country. However, in GBCC, since there is no numerical reference point for the result of concrete and quantitative assessment for energy saving according to detailed items like Energy, Materials and Resources, Indoor Environment, etc., whether facilities are installed, and the part of application, item revision is necessary to assess installation criteria in quantitative method. In addition, in the items that belong to only LEED, Heat Island Effect or Light Pollution Reduction, Innovation in Design and the items that makes person who has passed LEED certification exam participate in design and grants points is needed to consider in domestic environment-friendly certification criteria additionally. Examining certification system of another country, I could realize that we should make an appropriate and reasonable environment-friendly certification system fitting the actual conditions of our country and the government needs to cooperate and support to spread and promote the construction of environment-friendly buildings through the promotion of environment-friendly building

related industry and the consideration of incentive granting plan, etc.

ACKNOWLEDGEMENT

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