



Study for Improvement of Domestic System through Regulation based on Comparison of Green Building Certification System Analysis - Focused on the G-SEED, BREEAM

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ABSTRACT

The main purpose of the green buildings by reducing energy consumption and carbon footprint of the building society, global as to ensure the sustainability of the building and the environment. These regulations and schemes are used to activate the green buildings were made on the basis of the relevant laws and regulations. Mainly in the research for the improvement of the domestic institutional assessment items, the analysis of the legislation was fundamentally focused on Scoring the incomplete state. The analysis based on the laws and regulations of the institution is the way to know the purpose and direction of the respective certification. This study was performed in the following order to target the new commercial buildings. First, the analysis of the geungeobeop G-SEED and BREEAM. Second, we analyze the content and method of building energy performance in the certification system. As a result, Green Building Act is broad in relation to the composition of the contents are building for the activation energy green building and EPI is dealt with in an abstract and presented the applicability of such documentary content of insulation and airtightness, efficient machine. In contrast, the UK has been directly limit the carbon footprint of buildings in the Building Regulations Part L and evaluate them in BREEAM. This analysis of the ways to reduce substantially the energy for domestic green building regulations should be addressed through the feed.

KEYWORD

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1. Introduction

1.1. Background and purpose of the study

A new, globally competitive certification regime is being attempted, by integrating the GBCC system and the house performance certification system based on the existing Construction Act and the Housing Act in 2013. The new regime, given with a fancy brand name that goes G-SEED (Green Standard for Energy and Environmental Design,) however lacks any improvement of the environment certification criteria for offices, schools, or commercial facilities. The only difference it has is some new items for evaluating multi-unit houses for environmental certification in addition to what they already had in the existing housing performance certification regime. The issues regarding relevance of the domestic certification system and improvement of the criteria to ensure a practically valid set of standard have been pointed out and demanded for a long time. However, such voices have never been heard as the system has been revised repeatedly. For this reason, the housing suppliers in Korea obtain LEED

certifications of the United States to increase the properties' market values and promotional advantages. As of 2013, 95 buildings have been registered or filed for a registrations, indicating the LEED has firmly placed its roots in Korean market.

Recently, attempts have been made to obtain BREEAM certification, which is a green building certification regime in UK. BRE, the operating agency of BREEAM system, provides customized certification systems in consideration of the culture and climatic characteristics of each country where possible candidate buildings are located.¹⁾

Even if the BRE provides a customized scheme for Korea, it is basically a necessity to analyze the differences between BREEAM and the domestic scheme (G-SEED.) Especially, due to the fact that LEED, GREEN STAR, or other systems have been developed based on BREEAM, the analysis on the background, purpose, evaluation items and the methods is an essential step to endow the

1) It is divided into the National Scheme Operators and BREEAM International Bespoke. The National Scheme Operator is a nation wide system, which require one to two years for preparation. The BREEAM certification operation is commissioned by BRE Global. (EX: BREEAMES, BREEAM SE, BREEAM NOR). On the other hand, the International Bespoke is composed of a simplified manual, which is intended for buildings in countries which failed to get the qualifications mentioned above. The manual is to be applied for each individual building, and the preparation time required ranges from two to three months.

domestic system to have a even a slight chance to present itself as a something resembling a competitive scheme in the global market.

In many previous studies, the systems in effect in foreign countries have been compared and analyzed to provide a suggestion for improvement. However, they went no further than the comparison between the allocation of point and proportion between items. The fundamental analysis and comparison between the systems still have a far way to go. The legal analysis, which provide a background for the certification systems' understanding, may be a way to find out the purpose and directions.

In this regard, the purpose of this study is to compare the building regulations and the Law on Promotion of Green Buildings, which have been the basis of the G-SEED and BREEAM, as a basis to analyze the two systems and provide a suggestion for future direction for G-SEED.

1.2. Method and scope of the study

The comparison of the systems in Korea and other countries has been made in terms of the characteristics of the systems, the evaluation items, and the allocation of the score. However, a system in a country is based on the legal system of ti, and the way an individual item is handled differ in terms of the contents and the methods.

This study was conducted with the new office buildings, in accordance with the government's initiative requiring improvement of the energy performances of the new buildings, for, firstly, identifying the differences between the provisions of the laws that provide legal basis for th systems, by comparative analysing the Law on Promotion of Green Buildings and the Plan for Building Energy Saving Plan, as well as the legal bases of the BREEAM system, which are the Building Regulations and the App[roved Documents. Secondly, in accordances with the characteristics of the certification system which aims to reduce the carbon emission and saving the energy for buildings, the method and contents of the building energy evaluation were analyzed to suggested a way to improve what Koreans have introduced as their own version of green building certification system.

2. Laws and regulations in Korea and other countries related to green buildings

2.1. Green building related laws in Korea

1) The Law on Promotion of Green Buildings (or A.K.A. Green Building Act)

In February 2013, the Ministry of Land and Transportation enacted the Green Building Act, base don the Basic Law on Low-Carbon Green Growth as the legal basis for various

government initiatives to meet the goal of reducing the green house emission of buildings to 26.9% compared to BAU. The law is composed of a total of five chapters and 31 articles, which are mainly about (1) planning and interconnecting, (2) establishment of information systems, (3) policies on energy management for buildings, (4) supportive organizations, and (5) project support and reporting system establishment. 2)

Table 1. The Contents of Green Buildings Act

Chapter	Contents
Chapter 1	General Rules
Chapter 2	Master Plan of the Green Building Composition
Chapter 3	Energy and Greenhouse Gas Management Plan for Green Buildings
Chapter 4	The Implementation of Green Building Rating System
Chapter 5	Creating Green Building Realization and Support

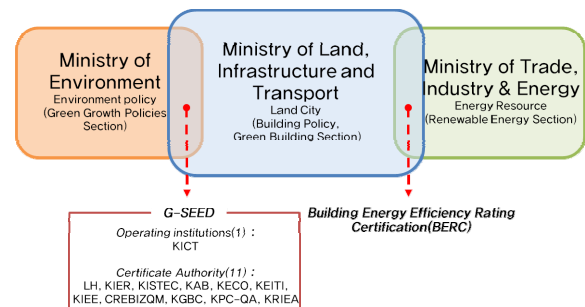


Fig 1. Operating Systems of G-SEED & BEREC

Chapter 1 of the law is about presenting the purpose, definitions, and basic principles of the law, while Chapter 2 (Basic plans for establishing a green building) requires that the basic plans for green house gas reduction, man-power training, development plans, or other execution plans should be established in every five years. Chapter 3(Building energy and green house gas management measures) requires that there should be an expectable information system, such as the green house emission status survey. Chapter 4 (Execution of the green building classification system) defines the details of the execution of the certifications for invigoration and energy management with efficiency for buildings. Chapter 4 is about the man-power training, development, pilot programs, and incentives to promote green buildings. The Green Building Act functions as the legal basis for the government to propagate the 'realization of green construction.'

Green Building Certification has been operated in accordance with the existing Construction Act, like the Building Energy Saving Plan and the Certification of the Building Energy

2) 이민석 외 2, 녹색건축물 활성화를 위한 제도 기반 구축 방안 연구, 건축도시 공간연구소 연구 보고서, 2011

Efficiency, until Chapter 4 of the Green Building Act was introduced. When the legal basis was transferred, there were some changes made. However, there are still possibilities of confusion because the Green Building Certification system and the Building Energy Efficiency Certification Program are jointly managed by the Ministry of Land and Transportation + Ministry of Environment, Ministry of Land and Transportation + Ministry of Industry, Commerce, and Resources, due to conflicts of interests between these ministries and confused civil servants.

2) Building Energy Saving Design Criteria and Energy Performance Index Review Document

Building Energy Saving Design criteria (Article 14 and 15 of the Law on Promotion of Green Buildings and Article 10, 11 of the Execution Decree of the same law, as well as Article 7 of the Execution Rule for the same law) includes criteria on thermal preservation and other energy saving design criteria, the energy saving plan documents, and the design review document preparation criteria, and the loosening the regulatory grasps to facilitate building Green Buildings. The EPI, or the Energy Performance Index is the criteria used to score the energy items under the Green Building Certification System. This evaluates four items of construction, machinery, electricity, and sustainable energy, as divided into compulsory and recommended items. Normal buildings should score 65 points or higher, and the buildings that are built by public authorities should score no less than 74 points in total.

The contents of the construction part include the thermal circulation, heat insulation, and the criteria for installing windows, to evaluate the insulation and tightness performance. The machinery and equipment portion evaluates the efficiency of the system, while the Sustainable energy item evaluates the proportion of sustainable energy being used for heating, air-conditioning, water warming, and electric capacity. The EPI Score is used as the energy performance evaluation method. Therefore, the higher the score is, the energy performance item score and the total score under the Green Building Certification program get higher. 3) However, a comparison between the EPI score and the primary energy consumption level of a building showed that the energy consumption was determined by the building plan and the types of the energy, as well as the energy sufficiency, which is independent of the EPI score. 4) This is because the EPI evaluation is focused on the system efficiency and the application, rendering it incapable of measuring the energy performance of the construction and the

system is a mere formality, which is practically irrelevant to actual energy saving.

2.2. British Building Regulations

The construction laws of Britain is composed of Building Act, Building Regulations, and Approved Document A-P. Britain strengthened its 2006 goal of reducing the carbon emission level by 28% compared to the level in 2002 by 25%, resulting in a goal to reduce the carbon emission by 46% from 2002. As such, Britain have been updating its Building Regulations continuously, with a view to realize zero-carbon emission by the year of 2019. (Fig. 2)

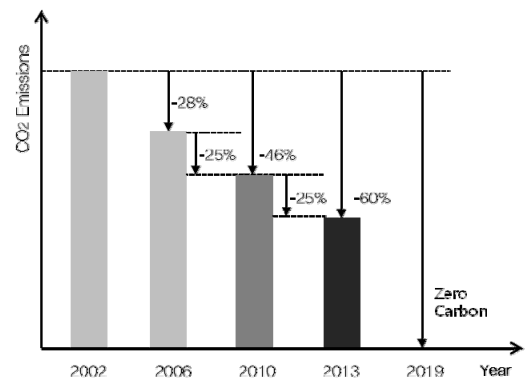


Fig 2. Building Regulations & CO₂ Emissions in UK

The Building Regulations' are composed of 10 chapters (Table 4) with a view to realize health safety, welfare, and convenience of the human users of the buildings as well as saving of fuel and power, prevention of water waste and contamination, preservation of the environment and improvement therefore, promotion of sustainable development, and prevention of crimes, by regulating the design, constructions, demolition, buildings, services related to buildings, or equipment.⁵⁾

Table 2. The Contents of Building Regulations

Chapter	Contents
Part 1	General
Part 2	Control of Building Work
Part 3	Notices, Plans and Certificates
Part 4	Supervision of Building Work Otherwise than by Local Authorities
Part 5	Self-certification Schemes
Part 6	Energy Efficiency Requirements
Part 7	Water Efficiency
Part 8	Information to be Provided by the Person Carrying out Work
Part 9	Testing and Commissioning
Part 10	Miscellaneous

3) 문미선 외 3, 친환경인증 받은 업무용 건물의 에너지성능지표 특점 분석연구, 대한건축학회논문집 제27권 제11호, p.364-372, 2011

4) 최광성 외 2, 에너지성능지표 평가에 따른 건축물의 에너지 사용량 및 절약성능에 관한 연구, 한국생태환경건축학회 추계학술발표대회 논문집 제 14권 제2호, P.96-97, 2014

5) 이민석 외 2, 녹색건축물 활성화를 위한 제도 기반 구축 방안 연구, 건축도시공간연구소 연구보고서, 2011

Especially, with regard to use of energy in buildings, Part 6 specifies the minimal required energy performance of building and carbon emission performance. For the sake of practical implementation of Part 6, the Approval Document⁶⁾ Part L(Conservation of Fuel and Power)has been introduced to provide a method of saving energy.

Part L is composed of New Dwellings(L1A), New Buildings Other than Dwelling(L2A), Existing Dwellings(L1B), and Existing Building Other than Dwelling(L2B) which correspond to different uses of buildings, while requiring that the carbon emission limits of the existing laws are observed. (Fig. 3)

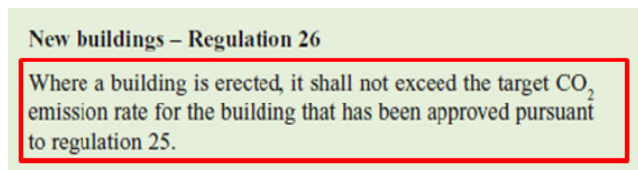


Fig 3. CO₂ Emissions of Part L

Part L2A, which covers new office buildings is composed of ① Introduction; generals, ②The requirements : legal requirements included in the building regulations, ③General guidance : definitions and building acts, etc., ④Design Standards : detailed design requirements and technical advises, ⑤Quality of construction and commissioning, ⑥Providing information, and ⑦ Model designs. Especially, ④ requires that the actual emission ratio of the building (BER) and required emission ratio in accordance with the Building Regulations (TER) are calculated, in order to ensure the BER does not exceed TER.

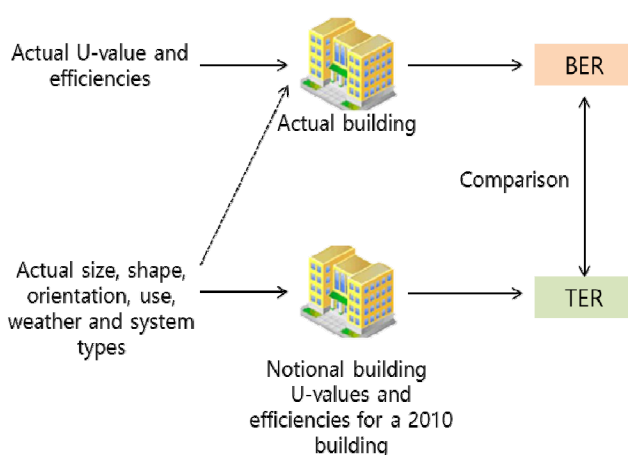


Fig 5. BER and TER of BREEAM

2.3. Comparative analysis on the laws and regulations related to green buildings

The Green Building Act and the Building Regulations were compared to one another to show that, while they are alike in the purpose of the reducing carbon emission and saving energy used in buildings and the fact that both regimes apply quantitative approaches for their goals, the biggest difference was the approach to their goals, which were summarized as in Table 3.

In Britain, all buildings are required to satisfy the regulations in the Construction Act, regardless of their BREEAM certifications. Also, the supporting documents for the Building Regulations, the method of calculating the carbon emission amount and precautions for designing a building are presented.

On the other hand, the Korean regulations only presents an overall, more general goals, which are not legally binding upon buildings. Rather than providing concrete instructions, they cover general information for executing lower-level schemes. With regard to the energies used in buildings, mose of the buildings are require to execute their energy saving plans. However, the scheme is still rather superficial, insufficient for making energy evaluation judgements. Therefore, it was obvious that a close link between the building energy and the scheme was wanting.

With this, it became obvious that G-SEED and BREEAM are fundamentally different from the very background of introducing the laws, as summarized in Fig. 5 and Fig 6 below.

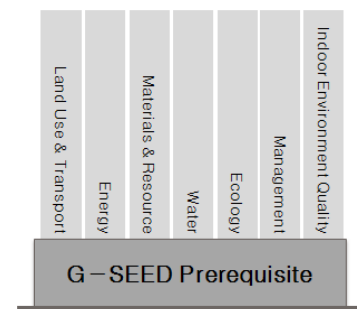
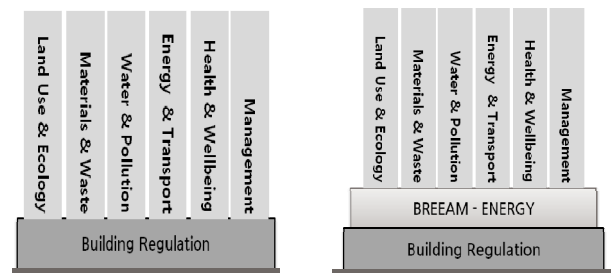


Fig 5. Based G-SEED Energy Rating



a. Pass~Very Good

b. Excellent, Outstanding

Fig 6. Based BREEAM Energy Rating

6) The Approved Document was introduced for practical execution of the Building Regulations. The document is divided into A through P.

Table 3. Domestic and International Green Building Regulations Comparison

		KOREA	UK
Designation		Green Building Act	Building Regulations
Regulation of CO ₂ Emissions		×	○
Legal Enforceability of the carbon dioxide emissions		×	○
Carbon dioxide emissions regulated building		· Buildings to get the G-SEED · Public Building	All Buildings
Main Contents		· Energy Standard of the Total Annual Energy Use · Submit energy saving plan · G-SEED · Building Energy Efficiency Rating · Energy Consumption Certification System	· Control of building work · Notices, Plan and Certificates · Supervision of building work otherwise than by local authorities · Self-certification Schemes · Energy Efficiency Requirement · Water Efficiency · Testing and Commissioning
Energy Saving Standard	Designation	EPI	Approved Document Part L
	Contents	· Architect : Insulation, U-value, Air Tightness · Machine : Using high-efficiency products · Electricity : Using high-efficiency products · Renewable Energy : Percentage of (Heating, Cooling, Hot-water, Electricity) capacity	· Building Emissions Rate(BER) ≤ Target Emissions Rate (TER) · Limits on design flexibility · Limiting the effects of solar gains in summer · Quality of construction & Commissioning · Providing information / O&M instructions
Related Certification		G-SEED	BREEAM

3. Domestic and overseas green building certification schemes

3.1. Green building certification

In the year 2002, this certification system was first introduced. After 13 revisions since then, now it has an evaluation system as shown in Table 4. After its introduction, the classification levels, the targets for certifications, evaluation items, and the method of scoring saw a major overhaul, while the existing evaluation/bonus items were changed to mandatory/evaluation items, making it look like LEED or BREEAM a little bit more. By multiplying the weighting factors to each total score of each item, the score was calculated out of a total of 100 points, which are then classified into Normal (Green tier 4,) Good (Green tier 3,) Very Good (Green tier 2,) and Excellent (Green tier 1).

Table 4 . G-SEED : Revision & Characteristics

GBCC			G-SEED		
Category	Point	Weights	Category	Point	Weights
Land Use	4	5%	Land Use & Transport	8	10%
Transport	4	5%			
Energy	21	25%	Energy	27	30%
Pollution	6	5%			
Materials & Resource	8	15%	Materials & Resource	8	15%
Water	13	10%	Water	13	10%
Ecology	12	10%	Ecology	12	10%
Management	9	7%	Management	7	10%
IEQ	21	18%	IEQ	21	18%

In 2013, the introduction of the Green Building Act changed the composition of the system into seven specialized fields. But, the criteria for evaluation, the contents, and the methods are unchanged. With regard to the energy of the building, the item of ‘Use of Sustainable Energy’ was newly introduced in 2008 and the Building Energy Efficiency Certification Criteria was newly introduced in addition to EPI for energy evaluation in 2010. However, as the result sets forth that the more advantageous score of the two is to be applied, it is far from being a relevant criteria of evaluating energy saving performance.

3.2. BREEAM

BRE first developed BREEAM(Building Research Establishment’s environmental Assessment Method) in 1990s. It is the world’s first comprehensive green building evaluation system. It has become the basis for many other systems, such as G-SEED, LEED, and GREEN STAR, both in Korea and other countries.

BREEAM is subject to the influence caused by the revisions of Building Regulations. Due to the strengthening of the emission regulation goals in 2010, the Scheme Structure, Minimum Standard, energy evaluation method, and some other evaluation items were changed. The portion of BREEAM 2008 which were operated depending on the types of buildings were now integrated under BREEAM New Construction 2011 as a comprehensive guideline to provide additional contents by the types of buildings. In BREEAM 2011, the allocated points to the maintenance and energy evaluation items increased to 12 and 9, respectively, it serves as a solemn reminder of the strengthening regulatory grasp of the emission.

Table 5. Category of BREEAM

Category	Ver.2008	Ver.2011	Weights
Management	10	22	12%
Health & Wellbeing	14	10	15%
Energy	21	30	19%
Transport	10	9	8%
Water	6	9	6%
Materials	12	12	12.5%
Waste	7	7	7.5%
Land use & Ecology	10	10	10%
Pollution	12	13	10%
Innovation	10	10	10%
Total Score			110

Table 6. Minimum Standard of BREEAM

Rating Minimum Standard	P ⁷⁾	G	V	E	O
Man 01. Sustainable Procurement	1	1	1	1	1
Man 02. Responsible Construction Practices				1	2
Man 04. Stakeholder Participation				1	1
Hea 01. Visual Comfort	* ⁸⁾	*	*	*	*
Hea 04. Water Quality	*	*	*	*	*
Ene 01. Reduction of CO ₂ Emissions				6	10
Ene 02. Energy Monitoring			1	1	1
Ene 04. Low or Zero carbon Technologies				1	1
Wat 01. Water Consumption			1	1	1
Wat 02. Water Monitoring		*	*	*	*
Mat 03. Responsible Sourcing	**	**	**	**	**
Wst 01. Construction Waste Management					1
Wst 03. Operational Waste				1	1
LE 03. Mitigating Ecological Impact			1	1	1

BREEAM suggests, like the mandatory requirements of LEED, the Minimum Standard⁹⁾. While the required conditions to be met are different by the tiers, the requirements for Sustainable Procurement, Visual Comfort, Water Quality, and Responsible Sourcing should be met in all tiers. Also, the 'Energy 01. Reduction of CO₂ Emissions' is given as the minimal requirements only for the Excellent and Outstanding grade, applying a more strict criteria for higher tiers.

That is, while the pass to very good grades meet the requirements of the Building Regulations, the BREEAM assessment is more about the sustainability and eco-friendliness than energy. Here, the higher tiers are subject to more strict criteria, as they are to become the leaders of the green buildings.

7) BREEAM tiers. , Pass(P), Good(G), Very Good(V), Excellent(E), Outstanding(O).

8) * indicates that the conditions may differ depending on the types of the buildings.

9) As in LEED, there is a Minimum Standard. However, unlike LEED, where all requirements should be met regardless of the grades, the Minimum Standard in BREEAM for each tier is different.

3.3. Comparative analysis of the energy evaluation items

(1) Comparison of evaluation items

G-SEED assesses 6 items, as the 'Energy' and 'Prevention of Pollution' are combined into a single item of 'Energy and Environmental Pollution.' On the other hand, BREEAM evaluates nine items. The common items between the two schemes are 'energy performance,' 'installation of energy meters,' 'lighting energy,' and 'the use of sustainable energy sources.' In BREEAM, evaluation of the high efficiency equipments, such as the coolers, elevators, and escalator are also included. As for the mandatory items, G-SEED includes 2.1.1 Energy Performance, while BREEAM requires Energy 0.1 Reduction of emissions, 'Energy 02. Energy Monitoring,' and Energy 04. Low and Zero Carbon Technologies.'

Table 7. Energy Category : G-SEED & BREEAM 2011

Division	Assessment	Credits	Note*
G-SEED	2.1.1 Energy Performance	12	●
	2.1.2 Whether the Meter Installation	2	○
	2.1.3 Lighting Energy Saving	4	○
	2.2.1 Use of New Renewable Energy	3	○
	2.3.1 Reduction in CO ₂ Emissions	3	○
	2.3.2 Use of Certain Substances Prohibited for the Ozone Protection	3	○
BREEAM 2011	Ene 01. Reduction of Emissions	15	●
	Ene 02. Energy Monitoring	2	●
	Ene 03. External Lighting	1	○
	Ene 04. Low and Zero Carbon Technologies	5	●
	Ene 05. Energy Efficient Cold Storage	2	○
	Ene 06. Energy Efficient Transportation	2	○
	Ene 07. Energy Efficient Laboratory Systems	- ¹⁰⁾	-
	Ene 08. Energy Efficient Equipment	2	○
	Ene 09. Drying Space	-	-

* Note : ● Required, ○ Assessment

The energy performance valuation of these two schemes are assigned with higher amount of scores, 12 and 15 points, respectively. And, they serve the same purpose of reducing energy consumption and carbon emission. However, the method of evaluation differs, in accordance with the legal basis shown in Chapter 2. The Green Building Certification uses EPI and the Building Energy Efficiency Grade, while BREEAM uses the Building Regulations and the Approved Documents as the source of the methods. Here, an attempt is made to compare these methods.

10) BREEAM 2011's energy evaluation item. However, the new offices buildings are not applicable. So they are excluded.

(2) Comparison of the method of evaluating energy

Table 8 . BREEAM & G-SEED: Energy rating

BREEAM 2011			
Credits	EPC ratio	Minimum Requirement	
1	0.05		
2	0.15		
3	0.25		
4	0.35		
5	0.45		
6	0.55		
7	0.59	BREEAM Excellent : 6 Credits : Also Requires a CO ₂ calculation of 0.22 which is equivalent to a 25% improvement over current Part L regulations	
8	0.63		
9	0.67		
10	0.72		
11	0.75	BREEAM Outstanding : 10 Credits : Also Requires a CO ₂ calculation of 0.30 which is equivalent to a 40% improvement over current Part L regulations	
12	0.79		
13	0.83		
14	0.87		
15	0.90		
G-SEED			
Average Rating of the Total Number of EPI	Weights	Building Efficiency Rating	Weights
More than 95 points	1.0	1star (preliminary)Certification	0.9
90 ~ 95	0.9	2star (preliminary)Certification	0.7
85 ~ 90	0.8	3star (preliminary)Certification	0.5
80 ~ 85	0.7	4star (preliminary)Certification	0.4
75 ~ 80	0.6		
70 ~ 75	0.5		
65 ~ 70	0.4		

The energy evaluation of BREEAM is changed from the existing EPC (Energy Preference Certification, 220008) to EPR (Energy Performance Rating, 2011.) While EPC only concerned the carbon emission of the target building compared to the standard, EPR does not present a minimum requirement for the emission but, instead, evaluates the three elements of the energy consumption, energy demand, and carbon emission in a comprehensive manner to calculate the ratio of saving compared to the national building. Then, by using the value calculated using the Building Performance Translator, the EPRNC is identified by applying it with the weighting factors, which will rate the target building with a score ranging from 1 to 15.

<Table 9> shows that the minimum score can be obtained when the EPR ratio is 0.05, which is a 5% improvement from the requirement for emission in the Building Regulations. This interprets to an energy consumption reduction of 30% or higher.

Table 9. Calculations of BREEAM EPR

Parameter	Definition	Allocated Weighting
Energy Demand	How well the building reduces heating and cooling energy demand	0.28
Energy Consumption	How efficiently a building meets its energy demand	0.34
Total CO ₂ Emissions	How much CO ₂ the building will emit in order to meet the energy demands	0.38

On the other hand, G-SEED is a method of evaluating the energy performance, by taking the more advantageous score from EPI or the Building Energy Efficiency Certification classes. As mentioned above, it is far from relevance in saving energy. Only 65 points for the sum of the EPI average is all that is needed to earn the weighting factor of 0.4, to give the building $12 \times 0.4 = 4.8$ points, which qualifies the building above the minimum requirements. There, the building now means the energy saving requirements. EPI 65 points is the lowest requirement to qualify for a normal grade building in accordance with the Construction Act. therefore, the minimum requirement for EPI is set too low, which is far from desirable as a means to promote green construction.

Energy Consumption Evaluation Score Y

$$= 15 \times (\text{EPI Points} - 60) \div 25 \quad (\text{Equation 1})$$

Also, the Building Energy Efficiency Certification grades divides the total energy demands from heating, air conditioning, hot water, lighting, and ventilation, dividing it by the total floor area and converting it using the correction factor to calculate the primary energy consumption amount. This is not about calculating the total energy volume of the building but to evaluating the energy consumption by each component.

In BREEAM, in measuring the energy performance as above, not only the amount of energy but also the amount of carbon emission is considered, based on objective and quantitative results, which are converted into scores and used to grade the buildings. Also, to earn the points, it is required to improve the energy efficacy by 5% or more. The higher tiers should make an improvement by 25% or 40%.

On the other hand, G-SEEDs evaluates the buildings with document-evaluated EPI or the energy efficiency certifications, which is determined by the primary energy consumption level. While it is possible to identify the amount of energy used in a building, it is not possible to know the amount of carbon emission. Also, if EPI, which is rather easier to obtain than the building energy efficiency certification, it is difficult to measure the actual energy consumption. If the EPI is about evaluating the design criteria for energy saving, the certification is desired to use the a stronger criteria to measure the efficiency rates or demand a certain level of EPI average by default and apply the acquired energy certification as a weighted value, in an effort to strengthen the evaluation criteria.

Conclusion

The main purpose of a green building is to reduce the energy consumption of a building and cut back on carbon emission to ensure sustainability of buildings and the environments in a global scale. To serve such a purpose, many sachers and regulations were

created. And, each of them is supported by the supporting provisions of the law.

In this study, the supporting legal provisions for G-SEED and BREEAM were compared and analyzed, to yield following outcomes in summary.

Firstly, the Green Building Act, which is the legal basis for the Green Building Certification Scheme of Korea is mainly focused on methods to promote green buildings, basic plans, incentives, operation of the certification problem, training, incentives, and others, in a wide ranged and abstract manner. And, for EPI, the documentary instructions are given in terms of the thermal insulation, tightness, and efficient use of machines. On the other hand, the Building Regulations of Britain directly limits the emission amount of carbon and requires buildings which are not BREEAM certified to satisfy certain legal requirements nonetheless.

Also, in Part L, which is in a similar context with the energy saving plan of Korea, the design, constructions, and commission of a building with regard to energy are covered, involving the entire life cycle of the building in terms of energy.

Secondly, the energy performances in G-SEED and BREEAM are evaluated based on laws. BREEAM requires that the buildings BER should not exceed TER and the energy efficiency of the building should be higher by 5% than the requirement to get points during evaluating. Also, it is required to calculate the total amount of energy used by the building. On the other hand G-SEED allows applying the more advantageous of the EPI or the energy efficiency certification grades. The minimum criteria already reflects the legal requirements for the EPI, to the following should be considered.

(1) A structure in which passing only the legal requirement gives the building zero points, and higher scores should be earned in proportion.

(2) The EPI already has a legal standard. Therefore, it should be taken as the default requirement and the acquisition of the energy efficiency grade should result in weighted advantages.

The policies of a nation are built based on the systems in operation in the country. Therefore, it is not possible to say which is more superior or inferior. However it seems that, in order for a policy serve it purpose, concrete contents and should prepared, and they should be able to be evaluated. While a series of attempts to revise the laws and the policies are made, as they are more focused on the allocation of the scores, proportions, and contents, it is believed that an analysis of the legal basis and revision of them should be covered as well.

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Reference

- [1] BREEAM New Construction Non-Domestic Buildings Technical Manual, BRE, 2011
- [2] BREEAM Scheme Document SD096, BRE Global Ltd 2013
- [3] Building Regulations 2010
- [4] Building Regulations 2010 Conservation of fuel and power L2A, HM Government, 2010
- [5] 국토교통부, 업무용 건축물 인증심사기준 // (Ministry of Land, Infrastructure and Transport, "Evaluation Criteria certification of commercial buildings")
- [6] 에너지관리공단, 건축물 에너지효율등급제도 소개-주요 개정사항 중심으로, 2013// (Korea Energy Management Corporation, "Building energy efficiency rating system introduction - the main center with amendments", 2013)
- [7] 이민석 외 2, 녹색건축물 활성화를 위한 제도 기반 구축 방안 연구, 건축도시공간연구소 연구보고서, 2011 // (Lee, Min-Seok, Seong, eun-Young, Lim, Kang-Ryoon, "Establishment of systematic Basis for Activation of Green Building", Architecture&Urban Research Institute, 2011)
- [8] 이현주, 김정택, "업무용건축물에 대한 녹색건축인증제와 LEED의 에너지 평가방법 비교", 한국생태환경건축학회 학술발표대회 논문집 통권 25호(v.13 n.2), 2013 // (Lee, Hyun-Ju, Kim, Jeong-Tai, "A Comparison of G-SEED with LEED for Energy Evaluation in an Office Building", Journal of Korea Institute of Ecological Architecture and Environment, Vol 13, No.2, 2013)
- [9] 장현숙, 이상호, "G-SEED 평가항목별 중요도 및 문제점 비교연구", 한국생태환경건축학회 논문집 제 14권, 제1호, 2014 // (Jang, Hyun-Sook, Lee, Sang-Ho, "A Comparison Study on the Importance and Problems of Assessment Items of the G-SEED System", Journal of Korea Institute of Ecological Architecture and Environment, Vol 14, No.1, 2014)
- [10] 정지나,태춘섭,양정훈, 박상동, "업무용 친환경건축물인증 개정 전·후 기준의 비교분석에 관한 연구", 대한건축학회 제27권, 제2호, 2011 // (Jung, Ji-Na, Tae, Choon-Seob, Yang, Jeong-Hoon, Park, Sand-Dong, "A Study on the Comparative Analysis of Old and New Versions in Green Building Certification Criteria for Office Building", Architectural Institute of Korea, Vol.27, No.2, 2011)