



Assessment Items of Outdoor Environment through Analysis of SITES - Focused on the Comparison with G-SEED and LEED -

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ABSTRACT

Although assessing outdoor environment and green space in terms of sustainability and environmental performance is perceived as an important issue, most existing green building certification systems are more focused on buildings and indoor environment. Recently, the Sustainable Site Initiatives (SITES) has been developed by American Society of Landscape Architecture in order to evaluate sustainability of site development and outdoor environment. Separate from LEED, the SITES are increasingly receiving attentions as a reliable certification system in the United States. As a preliminary study to develop the items of outdoor environmental assessment, the present study is purposed to analyze the assessment items, grading system and applicability of SITES for better understanding on the system. Also it was compared to existing green building certification criteria, including G-SEED, LEED-NC, and LEED-ND in order to investigate similarities and discrepancies. The results would provide insights and basic data to improve assessment items for outdoor environment of G-SEED.

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KEYWORD

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1. Introduction

1.1. Background and Objective of the Research

Environmental and resource issues such as global warming, resource depletion, water shortage, and green house gas emissions have been raised since 1990, many countries have introduced green building certification systems for development that could adapt to climate change. The UK first developed a certification system called BREEAM in 1991, followed by the US introducing LEED V1.0 in 1998. Korea also introduced its green building certification system in 2002. These certification systems have evolved to address new markets and building types, advances in practice and technology, and various project scopes. Individual buildings were the focus of the certification systems at the initial stage, but the focus has shifted to environmental issues in a city or a neighbor unit. Therefore, green building certification systems in many countries have evaluation systems for cities and/or neighbor units independent from those for individual buildings. Such examples are BREEAM-Communities of the UK, CASBEE CITY of Japan, and LEED-ND of the US.

Another improvement to green building certification systems is that the assessment items for sustainable site development and eco-friendly outdoor environment have been developed and

expanded. In the US, the Sustainable Sites Initiative (SITES) was created in 2012 in order to ensure the sustainable development of landscape and outdoor environment of all sites such as an outdoor space of a building, parks, and open spaces. This type of system covers from the site development planning to design and maintenance to ensure integrity and sustainability of design and provides comprehensive evaluation items. On the other hand, Korea's green certification system mainly emphasize energy performance of a building, and has a limited number of items for outdoor environment that should be considered at a construction planning stage (Park C. H. et al., 2009). Furthermore, the outdoor environment evaluation is getting more important in other countries, the number of items for outdoor environment evaluation has been reduced in Korea's green certification system after several revisions (Park C, H, et al., 2009; Yoon Y. H. et al., 2011). There have been calls for review and supplementation of the certification system due to lack of assessment items related to ecological and outdoor environment (Seong S. T. et al., 2012), any visible improvements have not been made.

This research aims to analyze evaluation items and methods of SITES, a rating system for sustainable site development and outdoor environment, and compare it with outdoor environment assessment items of LEED and Korea's green building certification so as to seek improvements for outdoor environment evaluation items. Under the circumstance that there is a insufficient number of outdoor environment and green space assessment items, this

research serves to be a basic research for the establishment of appropriate, realistic, and practical outdoor evaluation items. It is expected that this research can be utilized as a material for discussion on developing a reasonable outdoor environment evaluation system.

1.2. Scope and Methods of the Research

This research analyzed SITES items as of 2009. To compare it with LEED, outdoor assessment items of New Construction (NC) and Neighborhood Environment (ND) of LEED Version 3.0 were used. Also, for comparison with Korea's certification system, outdoor environment items from Green Standard for Energy & Environmental Design (G-SEED) for apartment buildings were used. Previous research and documents related to green certification systems were reviewed, and evaluation items and their purposes, criteria, evaluation methods, etc. were also reviewed based on materials obtained via the internet. Then, outdoor environment evaluation items were sampled after consultation with experts on landscape and construction. Based on the result, similarities and discrepancies between items, and evaluation standards and methods of common evaluation categories and items were analyzed.

2. Previous Research on Outdoor Environment in Korea

Oh S. H. et al. (2004) evaluated eco-friendliness of residential complexes using evaluation indicators of land use, transportation, and ecological environment from Korea's certification system in order to compare and analyze eco-friendliness of outdoor environment in new built-up areas in Seoul and 62 public residential complexes in new towns in the metropolitan area. Seong S. T. et al. (2012) compared the status of 20 complexes which obtained the green building certification to identify imbalance between items for outdoor space evaluation. It also used three assessment categories – land, transportation, and ecological environment – as outdoor environment evaluation items. It pointed out the problem that there is no minimum points required in the ecological environment category and the certification is granted when there is a high score in a certain category. Also, the research suggested that the certification system should be improved with minimum required points.

Lee K. I. and Kim M. S. (2008) analyzed Korea's evaluation indicators for outdoor environment of apartment buildings and created preliminary evaluation indicators categorized into four ecological principles. By conducting a survey targeting construction and landscape experts to identify the priority of

evaluation items, they found out that green space, water purification, rainfall infiltration, and green network were considered important, while food production, independent fertilizer, geo-thermal use, etc. were regarded less important. The research pointed out that while awareness about maintaining functions of ecology by creating an outdoor ecological habitat has improved, there is low recognition on progressive plans such as creating the culture of food production by creating fields and fertilizer facilities, and utilizing renewable energy in preparation for energy depletion. Park. C. H. et al. (2009) compared outdoor evaluation-related items of green building certification systems in Korea, the US, and Japan, pointed out that Korea's certification system has a very limited number of outdoor environment items, and stressed the importance of environmental consideration on site itself. Yoon Y. H. et al. (2011) analyzed the changes in the ecological environment category by comparing the previous and revised certification system. They pointed out that the revised certification system showed significant drop in the number of land use and outdoor ecological environment items and their weight. Regarding the revision that excluded several ecological environment items, limited their scope, and introduced the ecological area rate that provides weight to water retention function by space type, they claimed that the ecological area rate is related to ecological environment, but it cannot replace the quality of ecological environment, which led to shrinking of the number of evaluation items and their weight. Yoon T. H. et al. (2011) suggested that items that can objectively measure the quality of ecological environment should be included to improve the quality of environment and provide habitat to various creatures by establishing unique ecological space.

There have been many studies on the green certification system and their criteria, but research on outdoor environment evaluation items is somewhat limited. Also, even if there is such research, it only compares with LEED in the U. S., which focuses on building certification, so research on comprehensive and specific outdoor environment assessment items is insufficient. Therefore, this research compares systems and items that can comprehensively evaluate eco-friendliness of outdoor environment to seek implications for the development of Korea's outdoor environment evaluation system and criteria.

3. Outdoor Evaluation Items of Certification Systems in Korea and Other Countries

3.1. G-SEED

The Green Standard for energy and Environmental Design (G-SEED) was implemented on March 23, 2013 under the Green

Table 1. Assessment Items of Outdoor Environment & Points of G-SEED (Apartment Buildings)

Category	Evaluation Items	Point
Land use & transportation	1.1.1 Ecological value of existing site	2
	1.3.1 Community facility	3
	1.3.2 Pedestrian walkway inside complex	3
	1.3.3 Outside pedestrian walkway network	2
	1.4.1 Proximity of public transportation	2
	1.4.2 Bike storage and bike road	2
Materials & resources	3.4.1. Use of certified green products for effective recycling(prerequisite)	3
	3.4.2 Information display for carbon emissions of materials	2
Water circulation management	4.1.1 The validity of rainwater load reduction measures	4
	4.2.2 Rainwater utilization	4
	4.2.3 Install Graywater	3
Maintenance	5.1.1 Rationality of site management plans considering the environment	1
Ecological environment	6.1.1 Green network	2
	6.1.2 Green space ratio	2
	6.2.1 Ecological area ratio(prerequisite)	10
	6.3.1 Biotope creation	4

Building Development Support Act that mandates the incorporation of the Green Building Certification criteria and the Housing Performance Recognition system. The Green Building Certification criteria had been implemented since 2002 by the Ministry of Land, Transport and Maritime Affairs and the Ministry of Environment in order to evaluate eco-friendliness of a building. The Housing Performance Recognition system had been introduced since 2006 by the Ministry of Land, Transport and Maritime Affairs to check the quality and performance of a residential building. However, due to redundancy in assessment items in the two systems and a complex application process, they were reorganized to G-SEED in 2013. The difference between the previous two systems and G-SEED is that the evaluation categories were restructured from 9 to 7 by combining land use & transportation and energy & pollution. Also, the existing assessment items in the Housing Performance Recognition system were moved to a housing performance category.

Outdoor environment and landscape items in G-SEED criteria are mainly under the ecological environment category, but they are also related to several items in the land use & transportation, materials & resources, water circulation management, and maintenance categories. The recent revision caused no big changes in outdoor environment assessment items, and the assessment items of outdoor environment and points of G-SEED used in this research is shown as Table 1. By reviewing the criteria and excluding items only for buildings, 16 items were selected with the total of 49 points. Among them, two items related to use of certified green products and green space ratio are essential with 13 points in total.

3.2. LEED-NC and LEED-ND

LEED (Leadership in Energy & Environmental Design) is a US

Table 2. Assessment Items of Outdoor Environment of LEED- NC & LEED-ND

LEED-NC	LEED-ND
<ul style="list-style-type: none"> • Brownfield Redevelopment • Site Selection • Stormwater Design—Quality Control • Stormwater Design—Quantity Control • Water Use Reduction • Water Efficient Landscaping • Protect or Restore Habitat • Maximize Open Space • Public Transportation Access • Heat Island Effect • Bicycle Storage and Changing Rooms • Light Pollution Reduction 	<ul style="list-style-type: none"> • Brownfield Redevelopment • Floodplain Avoidance • Agricultural Land Conservation • Smart Location • Wetland and Water Body Conservation • Stormwater Management • Wastewater Management • Water-Efficient Landscaping • Minimized Site Disturbance in Design and Construction • Site Design for Habitat or Wetland and Water Body Conservation • Heat Island Reduction • Steep Slope Protection • Bicycle Network and Storage • Historic Resource Preservation and Adaptive Use • Light Pollution Reduction

green building certification system by the US Green Building Council (USGBC). LEED-NC (New Construction) targets designs and construction of new and renovated buildings. Evaluation criteria is categorized into 7 – Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, Innovation in Design, and Regional Priority – consisting of 43 items with eight essential items. Outdoor environment items are in Sustainable sites and Water Efficiency categories, and details are in Table 2. The total score is 110 and grades are divided into four – Platinum, Gold, Silver, and Certified under an absolute evaluation.

Developed by USGBC in 2007, LEED-ND (Neighborhood Development) is a certification system for neighbor unit development consisting of more items related to outdoor environment items. Unlike other LEED evaluation systems focus on buildings, LEED-ND highlights the placement of buildings and facilities, the site selection in the context of regional context and landscape, designs, and construction elements. It aims to make designs and construction process more healthy, economical, and sustainable. There are 56 assessment items including 12 essential ones, and five evaluation categories such as Smart Location and Linkage, Neighborhood Pattern and Design, Green Infrastructure and Buildings, and Regional Priority Credit. It mainly contains site selection and development, and linkage at a neighborhood unit.

4. SITES

4.1. Background and Intent

Sustainable Sites Initiative (SITES) was developed by the American Society of Landscape Architecture, the Ladybird Johnson Wildflower Center of the University of Texas, and the American Association of Botanical Garden and Arboreta in order to assess sustainability and eco-friendliness of the process from site

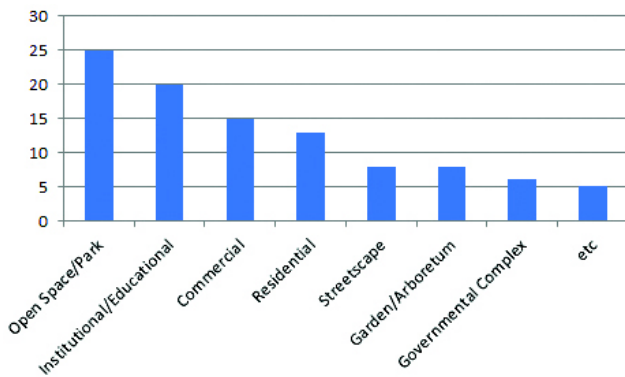


Figure 1. Project Types of the SITES Pilot Program

development to maintenance. It is similar to LEED, but it is more useful for evaluating eco-friendliness of open space of a building, parks, green space, street space, and other various sites. SITES was first discussed in 2005 due to the fact that LEED system itself cannot evaluate comprehensive outdoor space and sites that does not include a building, and there was no guideline or benchmark for sustainable outdoor environment and green space development.

Starting with the technical commission that develops sustainable evaluation items for soil, hydrology, vegetation, human health and well-being, and material selection, a comprehensive assessment indicators that evaluates eco-friendliness from design, construction to maintenance in 2008. This year, the evaluation system will be revised. USGBC, which leads LEED, also participated in the development of SITES, and including SITES to LEED is under discussion. Aiming to become a national evaluation system, it has been continuously revised based on the results of adoption.

From open spaces like local, state, and national parts to reserved and buffer zones, educational, commercial, and military facilities, airports, arboretums, streets and plazas, residential sites and to campuses, SITES can evaluate various types of open spaces regardless of the existence of a building. Over 150 projects from June 2010 to June 2012 show that their sizes, types, and locations are very different. Among them, grey field projects accounted for 65%, green field 20%, and brown field 15%. Figure 1 shows the various targets of SITES.

4.2. SITES Evaluation System

SITES evaluates eco-friendliness of the entire outdoor space development process from site selection to construction, consisting of 9 categories – Site Selection, Pre-Design Assessment & Planning, Water, Soil & Vegetation, Material Selection, Human Health & Well-Being, Construction, Operations & Maintenance, and Monitoring & Innovation. Including 15 essential items, there are 66 assessment items, and essential items do not have points since they must be implemented. Among 9 categories, Soil &

Table 3. Assessment Items & Points of SITES

Evaluation Category	Evaluation Purpose	No. of items (Required)	Point
Site Selection	Select locations to preserve existing resources and repair damaged systems	7(4)	21(8.4%)
Pre-Design Assessment and Planning	Plan for sustainability from the onset of the project	3(2)	4(1.6%)
Site Design	Water	8(1)	44(17.6%)
	Soil and Vegetation	13(3)	51(20.4%)
	Materials Selection	10(1)	36(14.4%)
	Human Health & Well-Being	9(0)	32(12.8%)
Construction	Minimize effects of construction-related activities	6(2)	21(8.4%)
Operations and Maintenance	Maintain the site for long-term sustainability	8(2)	23(9.2%)
Monitoring and Innovation	Reward exceptional performance and improve the body of knowledge on long-term sustainability	2(0)	18(7.2%)
Total		66(15)	250(100%)

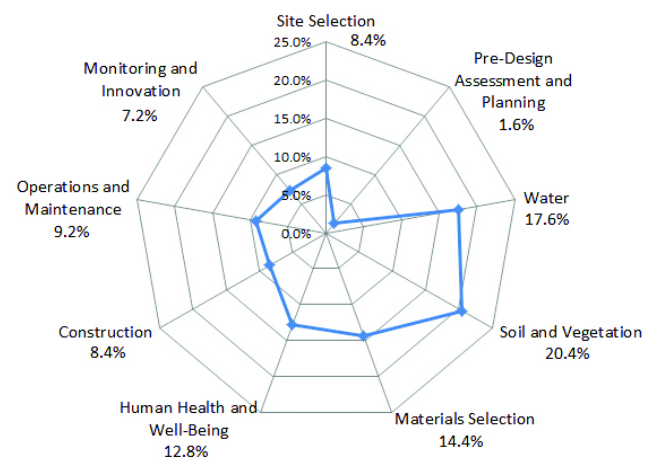


Figure 2. Breakdown of Points in Each Category of SITES

Vegetation takes up 20.4 % with 51 points, followed by Water and Material Selection with 17.4% and 14.4% respectively (Figure 2). Each item has different points according to the degree of implementation, and there are four grades according to the total sum of points. Four stars for over 200 points out of 250 points in total, three stars for over 150 points, two stars for over 125 points, and one star for over 100 points.

5. Comparison with SITES, LEED and G-SEED

Table 4 shows the comparison of assessment items of SITES with KEED-NC, LEED-ND, and G-SEED to indicate similarities and discrepancies. The content and names of evaluation items are

Table 4. Comparison of Assessment Items of SITES with LEED-NC, LEED-ND, and G-SEED

Evaluation Category	SITES	LEED-NC	LEED-ND	G-SEED	
Site Selection	*P.1.1. Limit development of soils designated as prime farmland, unique farmland, and farmland of statewide importance	SSc1	SLLp4	1.1.1 Ecological value of existing site 1.3.3 Outside pedestrian walkway network 1.4.1 Proximity of public transportation	
	P.1.2. Protect floodplain functions	SSc1	SLLp5		
	P.1.3. Preserve wetlands P.1.4. Preserve threatened or endangered species and their habitats	SSc1 -	SLLp3 SLLp2		
Pre-Design Assessment and Planning	**C.1.5. Select brownfields or greyfields for redevelopment	SSc3	SLLc2		
	C.1.6. Select sites within existing communities	SSc2	SLLc1		
	C.1.7. Select sites that encourage non-motorized transportation and use of public transit	SSc4.1/4.2	SLLc3/4		
Site Design	P.2.1. Conduct a pre-design site assessment and explore opportunities for site sustainability	-	-	4.1.1 The validity of rainwater load reduction measures 4.2.2 Rainwater utilization 4.2.3 Install Graywater 6.3.1 Biotope creation 6.1.1 Green network 6.1.2 Green space ratio 6.2.1 Ecological area ratio 3.4.1 Use of certified green products for effective recycling 3.4.2 Information display for carbon emissions of materials 1.3.1 Community facility 1.3.2 Whether to pedestrian walkway inside complex 1.4.2 Whether to install on bike storage and bike road	
	P.2.2. Use an integrated site development process	-	-		
	C.2.3. Engage users and other stakeholders in site design	-	-		
	Water	P.3.1. Reduce potable water use for landscape irrigation by 50 % from established baselines	WEc1		GIBc4
		C.3.2. Reduce potable water use for landscape irrigation by 75 % or more from established baseline	-		-
		C.3.3. Protect and restore riparian, wetland, and shoreline buffers	-		SLLc7
		C.3.4. Rehabilitate lost streams, wetlands, and shorelines	-		SLLc8
		C.3.5. Manage stormwater on site	SSc6.1		GIBc8
		C.3.6. Protect & enhance on-site water resources & receiving water quality	-		-
		C.3.7. Design rainwater/stormwater features to provide a landscape amenity	-		-
		C.3.8. Maintain water features to conserve water and other resources	-		-
	Soil and Vegetation	P.4.1. Control and manage known invasive plants found on site	-		-
		P.4.2. Use appropriate, non-invasive plants	-		-
		P.4.3. Create a soil management plan	-		-
		C.4.4. Minimize soil disturbance in design and construction	-		-
C.4.5. Preserve all vegetation designated as special status		-	-		
C.4.6. Preserve or restore appropriate plant biomass on site		-	-		
C.4.7. Use native plants		-	-		
Materials Selection	C.4.8. Preserve plant communities native to the ecoregion	-	-		
	C.4.9. Restore plant communities native to the ecoregion	-	-		
	C.4.10. Use vegetation to minimize building heating requirements	SSc7.1	-		
	C.4.11. Use vegetation to minimize building cooling requirements	SSc7.1	GIBc9		
	C.4.12. Reduce urban heat island effects	SSc7.2	GIBc9		
	C.4.13. Reduce the risk of catastrophic wildfire	-	-		
Human Health and Well-Being	P.5.1. Eliminate the use of wood from threatened tree species	-	-		
	C.5.2. Maintain on-site structures, hardscape, and landscape amenities	-	-		
	C.5.3. Design for deconstruction and disassembly	-	-		
	C.5.4. Reuse salvaged materials and plants	-	-		
	C.5.5. Use recycled content materials	MRc4	GIBc15		
	C.5.6. Use certified wood	MRc7	-		
	C.5.7. Use regional materials	MRc5	-		
	C.5.8. Use adhesives, sealants, paints, and coatings w/reduced VOC emissions	IEQc4	-		
	C.5.9. Support sustainable practices in plant production	-	-		
	C.5.10. Support sustainable practices in materials manufacturing	-	-		
Construction	C.6.1. Promote equitable site development	-	-		
	C.6.2. Promote equitable site use	-	-		
	C.6.3. Promote sustainability awareness and education	-	-		
	C.6.4. Protect and maintain unique cultural and historical places	-	GIBc6		
	C.6.5. Provide for optimum site accessibility, safety, and wayfinding	-	NPDc6		
	C.6.6. Provide opportunities for outdoor physical activity	-	NPDc10		
Operations and Maintenance	C.6.7. Provide views of vegetation and quiet outdoor spaces for restoration	-	-		
	C.6.8. Provide outdoor spaces for social interaction	-	NPDc9		
	C.6.9. Reduce light pollution	SSc8	GIBc17		
	P.7.1. Control and retain construction pollutants	-	GIBp4		
	P.7.2. Restore soils disturbed during construction	-	-		
	C.7.3. Restore soils disturbed by previous development	-	-		
	C.7.4. Divert construction and demolition materials from disposal	MRc2	-		
	C.7.5. Reuse or recycle vegetation, rocks, & soil generated during construction	-	-		
C.7.6. Minimize generation of greenhouse gas emissions and exposure to localized air pollutants during construction	-	-			
Monitoring and Innovation	P.8.1. Plan for sustainable site maintenance	-	-		
	P.8.2. Provide for storage and collection of recyclables	MRp1	-		
	C.8.3. Recycle organic matter generated during site operations & maintenance	-	-		
	C.8.4. Reduce outdoor energy consumption for landscape & exterior operations	-	-		
	C.8.5. Use renewable sources for landscape electricity needs	-	-		
	C.8.6. Minimize exposure to environmental tobacco smoke	-	-		
	C.8.7. Minimize generation of greenhouse gases and exposure to Points localized air pollutants during landscape maintenance activities	-	-		
	C.8.8. Reduce emissions and promote the use of fuel-efficient vehicles	SSc4.3	-		
Monitoring and Innovation	C.9.1. Monitor performance of sustainable design practices	IDc1	IDPc1		
	C.9.2. Innovation in site design	IDc1	IDPc1		

* P: Prerequisite; **C: Credit; SS: Sustainable Sites; WE: Water Efficiency; MR: Materials & Resources; ID: Innovation in Design; SLL: Smart Location & Linkage; NPD: Neighborhood Pattern & Design; GIB: Green Infrastructure & Buildings; IDP: Innovation & Design Process

similar between SITES and LEED, so a check-list method can be used. However, G-SEED has similar evaluation categories, but different content and names, so specific assessment items were listed. For instance, there is no evaluation items in SITES corresponding to the green space ratio and ecological area ratio of G-SEED, so those items were matched with the Soil and Vegetation category (Table 4).

LEED-ND and LEED-NC have common assessment items in the site selection, water circulation, health and well-being categories, but SITES has more specific and detailed items such as vegetation and soil, use of certified green products for outdoor facilities, green practices throughout the construction process, etc. There are similarities in outdoor the environment and site selection, water, soil and vegetation, material selection, and human health and well-being categories, but overall, SITES items are more comprehensive and concrete. G-SEED is similar to SITES in terms of the brownfields development, community space installation, proximity to public transportation, rainwater use, and rainwater load reduction measures. However, SITES involves specific items to assess sustainable and environmentally friendly methods during the outdoor space development procedure such as wetland conservation, use of native plants, control and management of known invasive plants, soil preservation, and management of construction and operation. G-SEED has the assessment items for green network, green space ratio, and ecological area ratio which have higher points, and specifically defines how to create biotope including how to deal with embankment borders and plant vegetation. On the other hand, SITES does not have a separate category.

6. Comparison of Assessment Items and Methods between SITES and G-SEED

The differences were studied since assessment items and methods may vary even the content related to the creation of green outdoor environment is similar.

6.1. Site Selection

G-SEED has an item of ecological value of existing site aiming at preserving environmentally valuable land resource by evaluating the environmental and ecological value of the existing site. It carries 2 points, calculated based on the share of site with low ecological value out of the total site. If the share is over 80%, 2 points with the highest weight are granted, and 0.8 points for over 50%. SITES and LEED have items for brownfields development, and SITES grants 5 points without weight to a project that develops greyfields, and 10 points to a brownfield development project.

6.2. Water Management

G-SEED's rainwater load reduction measure item evaluates the rainwater collection area and whether the rainwater storage and infiltration facilities and other rainwater drainage reduction facilities are installed. If the rainwater collection area is over 50% of the total site area, the highest points of 4 is granted, and lower points are given to 40%, 30%, and 20%. SITES differentiates rainwater items by projects – greenfields, greyfields, and brownfields. For example, in the case of a greenfield project, if water storage capacity does not exceed the level of pre-development level, in other words, the amount of leakage from development site does not increase, the total of 10 points are given. As for greyfields or brownfields, the highest point can be obtained if a project achieves 90% and 60% of the target water storage capacity respectively, which are set for each site. The 'site rainwater management' item grants relatively higher points, so rather than designating one method, it enables various creative measures to be applied such as creating rooftop gardens, improving soil, installing storage facilities, establishing rainwater gardens, etc. by setting the rainwater drainage reduction target.

In items related to rainwater use, G-SEED evaluates based on the fact whether facilities that uses rainwater for sprinkling water or landscape water are installed, but SITES assesses the reduction of water used for landscaping. More specifically, G-SEEDS stresses area by granting the highest score of 4 when a rainwater storage tank or retention facility which is over 0.05 of building area or 0.02 of site area. On the other hand, SITES gives the highest score when stored rainwater, greywater, air conditioner condensate, or water in a boiler or cooling tower is used for plant. In items related to heat island effect reduction, SITES grants 5 points for reducing the heat island effect of paved area and facilities by 60% and 3 points for 30% reduction by using paving material with solar reflectance index of over 29, installing a sunshade with solar panels, creating gardens on the rooftop, providing shades by planting trees, using grass blocks, etc.

6.3. Material Selection

There are only two items related to outdoor environment in the Material & Resource category of G-SEED: use of certified green products (3 points) and labeling information on carbon emission amount (2 points). Also, the weight of use of certified green products in the outside is only 1/3 of those used for buildings. On the contrary, SITES evaluates eco-friendliness of material selection through quite specific and various items such as reuse of plants, use of regional materials, design for deconstruction and disassembly, use of recycled materials, etc. If more than 90% of

materials, plants, and soil are purchased in the region, the highest score of 6 is granted.

6.4. Human Health and Well-being

Both systems highlight the importance of space and facility planning aiming at the well-being of residents and community creation, and provide evaluation items. As for G-SEED, the item related to community centers & facilities/space creation assesses whether those facilities in a complex meet certain levels. For example, 3 points are granted if community facilities or centers are planned and their area exceeds 1.1 times of areas defined by relevant laws. This is only applicable to apartment buildings, and when evaluating office buildings and schools, social space items are excluded. Regardless of the land use, SITES checks whether outside resting places where 5% of the total number of expected site users can sit are provided within 200 meters from the entrance. Along with various resting places for several people, the shade, and trees, if places for outdoor games and picnics, wireless internet, playgrounds and other facilities are provided, additional points are granted.

6.5. Ecology

G-SEED stresses a green network and grants the highest score of 2 points when green space of a site is linked with outside green space or biotope with over 8 meters in width. Also, the ecological area ratio is essential with 10 points. The highest scores for the green space ratio and ecological area ratio can be granted when the ratios exceed 25% and 50% respectively. SITES has no item on a green network or the green area ratio. The reason behind might be that the minimum green area is regulated by municipal ordinances.

Regarding biotope creation for natural habitat, G-SEED grants points when the area of aquatic biotope is at least 90m² with a depth of over 0.6m, and introduces plants that can prevent embankment flooding and help purify water. A land biotope should have at least 180m² of area with multitude layers, and be 1.5 times of the planting density defined in the municipal ordinance. Also, it should be over 3% of the site area. SITES evaluates ecological environment via items related to preservation and restoration of wetlands, preservation of threatened or endangered species and their habitats, and preservation of vegetation and soil.

7. Conclusion

The purpose of this research is to analyze assessment items and methods of SITES, a US outdoor environment and green space evaluation system, and compare it with those of Korea's certification system to seek improvements for Korea's outdoor

environment evaluation system. The conclusion is as below.

First, since SITES was created to assess outdoor environment and green space, independent from LEED, it has comprehensive evaluation items that can assess sustainability and eco-friendliness of outdoor environment throughout the entire project from planning to design, construction, and maintenance. Also, unlike LEED and G-SEED focusing on buildings or neighborhoods, SITES is applicable to green space or parks without building. This implies that for a sustainable site development and green outdoor environment creation, Korea should discuss a certification system that can evaluate green infrastructure including green space.

Second, SITES includes specific assessment items related to soil and vegetation, which fall under the landscape sector, such as preservation of soil and prevention of soil disturbance, preservation and use of native vegetation, and energy reduction through plant use. Also it has items related to providing space for physical activities and social bond in terms of human health and well-being, and socio-cultural aspects such as contribution to community development and preservation of historical sites. This is significant considering that sustainability does not only mean physical aspects, but economic and socio-cultural aspects.

Third, there are differences in evaluation items and methods between SITES and G-SEED. G-SEED has more quantitative standards such as the rainwater collection area, the ecological area ratio, the green space ratio, and the length of green space. On the other hand, instead of providing strict numbers to satisfy, SITES suggests targets and encourages to meet the targets by using various green strategies or technologies. For example, it grants points for reducing the heat island effect of paved area and facilities by using paving material with higher solar reflectance index, installing a sunshade, creating gardens on the rooftop, planting trees, etc. Evaluation standards and methods not only require verification on the usefulness and efficiency of quantification, but need flexibility to encourage creativity of designers and architects for sustainable development.

Since SITES, LEED-NC, LEED-ND, and G-SEED are specialized in different areas such as buildings, neighbor environment, and outdoor environment, and circumstances are different by countries, direct comparison with Korea's certification system has limits. However, this research aims to find implications for future improvements by comparing the scope and concreteness of outdoor environment evaluation systems, and expects more practical assessment items will be developed through more consideration and discussions on green evaluation for outdoor environment. Also, when referring to overseas assessment systems regarding outdoor environment, it is required to consider different conditions from Korea and adaptations should be made with caution.

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