

Comparative Analysis of Green Building Evaluation Systems in China, the United States, and Republic of Korea

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ABSTRACT

Green building evaluation systems are of significant importance for the development and implementation of green buildings. This paper compares and analyzes China's ESGB "Assessment Standard for Green Building" GB/T50378-2019 (2024 Edition), the United States' LEED V4.1, and Republic of Korea's G-SEED "Green Building Certification Standards" through research. By comparing aspects such as indicator types, evaluation objects, evaluation methods, and grade classifications, this paper summarizes the deficiencies and areas requiring further optimization in China's green evaluation standard system, proposes solutions aligned with ESGB, and offers recommendations for the development of existing evaluation systems.

KEYWORDS

Green building; LEED V4.1; ESGB; G-SEED; Evaluation system

1 Introduction

With the intensification of global environmental issues and the deepening of sustainable development concepts, traditional buildings can no longer keep pace with the progress of the times. The rise of green buildings has become unstoppable. The continuous promotion of green buildings, the increase in market demand, and the construction industry's aspiration for higher standards continuously drive the sustainable development of green buildings. Countries around the world have therefore implemented and formulated various policies to meet the demands of green buildings ^[1].

Green building evaluation systems provide systematic assessment for the implementation of green buildings. Their core objective is to guide the coordinated development of economy, society, and environment through quantitative indicators. Since the 1990s, countries around the world have successively established green building evaluation systems suitable for their own nations, such as the UK's BREEAM, the US's LEED, Japan's CASBEE, Australia's NABERS, and Canada's GBTOOL. Among them, the US LEED is one of the most widely recognized green building evaluation systems globally, and today's LEED possesses extremely high authority and influence internationally ^[2].

2 Current Development Status of Green Building Evaluation Systems

2.1 Current Development Status of China's Domestic Evaluation System

In 2001, China published its first text on green building assessment, the "Technical Assessment Manual for Ecological Housing in China." In 2003, Tsinghua University and other institutions conducted research work on the "Green Olympics Building Assessment System." In 2006, China promulgated its first national-level standard, "Assessment Standard for Green Building" GB/T50378-2006, thus initiating the standardization work of national-level green building evaluation systems. Following the 2006 version, after revision and supplementation, the second "Assessment Standard for Green Building" GB/T50378-2014 was implemented in 2014. In 2019, considering national conditions, the third "Assessment Standard for Green Building" GB/T50378-2019 was introduced, proposing "people-oriented, emphasizing performance, and improving quality" ^[3].

On October 1, 2024, the "Assessment Standard for Green Building" GB/T 50378-2019 (2024 Edition) was implemented with partial revisions mainly including: (1) coordination with current mandatory engineering construction codes; (2) strengthening carbon emission reduction performance requirements for green buildings; (3) optimizing implementation effectiveness and coordinating with current relevant standards. The continuous improvement of the green building evaluation system also marks the increasingly important social status of green buildings. From the 2006 ESGB to the 2024 ESGB, the evaluation indicator system has undergone relatively significant changes. The 2006 ESGB evaluation indicators consisted of six categories: land saving and outdoor environment, energy saving and energy utilization, water saving and water resource utilization, material saving and material resource utilization, indoor environmental quality, and operation management. The 2014 ESGB added an additional category of construction management to the 2006 version, consisting

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of seven categories of indicators ^[4].

The 2019 version consolidated and organized, and although it changed from seven to five categories, the evaluation scope became more extensive (Figure 1). "Improvement and Innovation" serves as a bonus category, encouraging performance enhancement and technological innovation in green buildings. The green building evaluation grades expanded from the original three levels of "one-star, two-star, three-star" to the current four levels, adding a "basic level" evaluation grade. As China's green building evaluation standards continue to improve, the evaluation standards will become more adaptable to the needs of environmental protection and sustainable development ^[5].

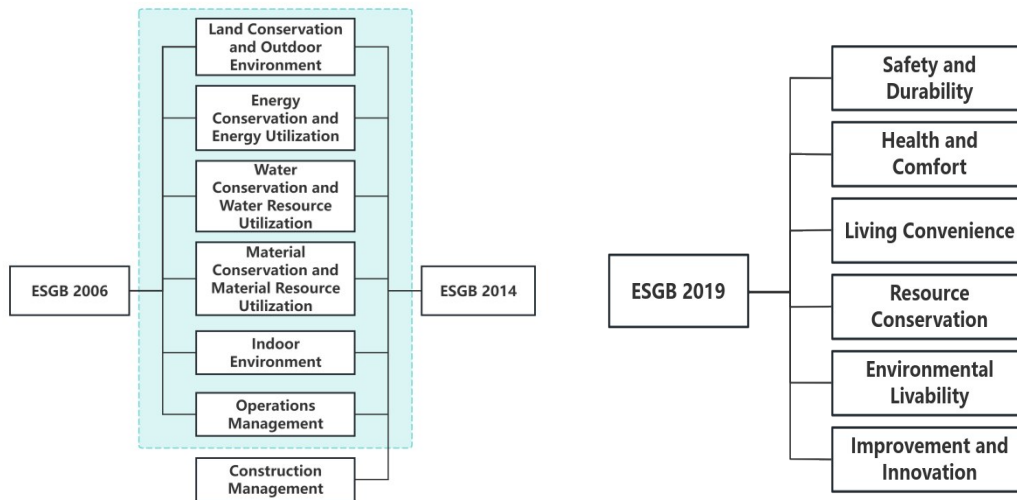


Figure 1 Changes in Evaluation Indicators

2.2 Current Status of Foreign Evaluation Systems Development

Starting in 1999, commissioned by the Ministry of Environment, the Korea Institute of Construction Technology conducted research on the introduction of a building environmental performance certification system. In 2002, the Ministry of Construction and Transportation and the Ministry of Environment jointly initiated environmental building certification for shared residential buildings. In 2003, environmental certification was extended to commercial buildings and residential complexes. In 2005, environmental certification for school buildings began, and the certification system was improved and revised that same year. In 2006, environmental building certification was implemented for accommodation and sales facilities. In 2013, the Green Building Construction Support Act was enacted, and the issuance of Green Building Certification and Housing Performance Grades (for shared housing) was redefined across seven professional fields (classification system). In 2018, the Green Building Certification Standard Operating Rules revised the certification review standards section [6]. G-SEED underwent a comprehensive update in 2016 to respond to changes in global standards and the development of green building technology. Not only were buildings categorized into new and existing, residential and non-residential, but the formulation and updating of certification projects also began to be implemented. The certification standards for existing buildings were revised, and the scope of target buildings was expanded. Although only one new project was added—the green retrofit certification standards and innovative design content—by 2016, the system covered the entire range of buildings. The introduction of the zero-energy building certification system and the adjustment of the innovative design field reflected the certification requirements for new technologies and products ^[7].

LEED (Leadership in Energy and Environmental Design) is a green building rating system launched by the U.S. Green Building Council (USGBC) in 1998. LEED v1.0 officially appeared in the public view. In March 2001, USGBC summarized the problems and deficiencies that emerged during the pilot program and released LEED v2.0. Subsequently, LEED v2.1 and LEED v2.2 were announced in 2002 and 2005, respectively. LEED v2009 (v3.0) was released in April 2009, LEED v4.0 was released in 2015, and LEED v4.1 was released in 2019 [8]. Currently, LEED v5.0 certification is also being piloted. LEED has become one of the most influential green building certification standards globally.

3 Comparative Analysis of Green Building Evaluation Systems

Since LEED V4.1 and G-SEED (2016-7) have different rating systems and scoring items for evaluation objects, this paper selects China's "Assessment Standard for Green Building" GB/T 50378-2019 (2024 edition), the United States' LEED V4.1 BD+C, and Korea's Green Building Certification Standard G-SEED (2016-7) for new residential projects for comparative

analysis.

3.1 Green Building Evaluation Indicators and Evaluation Objects

In ESGB GB/T 50378-2019 (2024 edition), the indicator types consist of five categories: safety and durability, health and comfort, living convenience, resource conservation, and environmental livability. Each category includes control items and scoring items, with additional points for improvement and innovation. Figure 2 shows the weight proportion of secondary indicators corresponding to primary indicators, where I: Safety and Durability; II: Health and Comfort; III: Living Convenience; IV: Resource Conservation; V: Environmental Livability. The "Resource Conservation" indicator includes content related to land saving, energy saving, water saving, and material saving. The evaluation objects in the green building evaluation system include three major parts: residential buildings, existing building renovations, and public buildings.

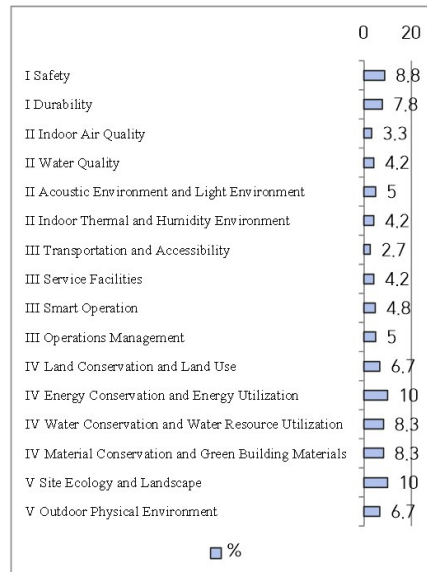


Figure 2 Weight Proportion of EGGB Indicators

In the U. S. LEED v4.1, evaluation objects mainly consist of the following components: Building Design and Construction LEED BD+C; Interior Design and Construction LEED D+C; Operations and Maintenance LEED O+M; LEED Residential; and Cities and Communities LEED C+C. LEED is holistic; as a framework, it addresses everything from energy and water use to material selection, waste management, and indoor environmental quality through a series of credit categories tailored to each rating system, reinforcing the core concepts of sustainability, resource efficiency, and environmental responsibility [8]. The evaluation indicators include: Integrative Process, Location and Transportation, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation, and Regional Priority—a total of 8 categories. The current assessment shows the weight proportion of LEED BD+C indicators, as shown in Figure 3.

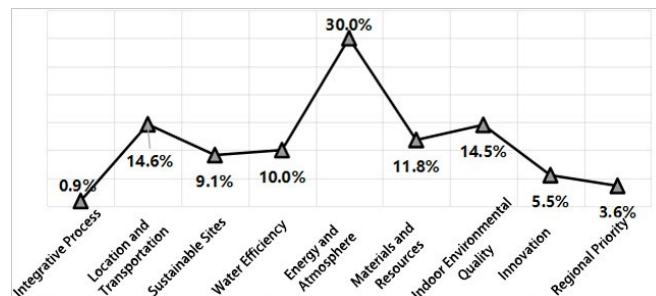


Figure 3 Weight Proportion of LEED Indicator

Korea's G-SEED includes three major categories of buildings: new buildings, existing buildings, and green retrofit buildings. New buildings are further subdivided into: new residential buildings, new non-residential buildings, and new detached housing. Existing buildings include: existing residential buildings and existing non-residential buildings. Green retrofit buildings are divided into: green retrofit residential buildings and green retrofit non-residential buildings. The indicator system currently evaluates new residential projects, which consist of 8 categories of indicators: land use and transportation, energy and environmental pollution, materials and resources, water cycle management, maintenance,

ecological environment, indoor environment, and innovative design, with innovative design being an additional scoring item ^[9]. Figure 4 shows the weight proportion of each indicator category. The development history of G-SEED reflects Korea's efforts and progress in the field of green buildings, demonstrating the country's continuous commitment to sustainable development.

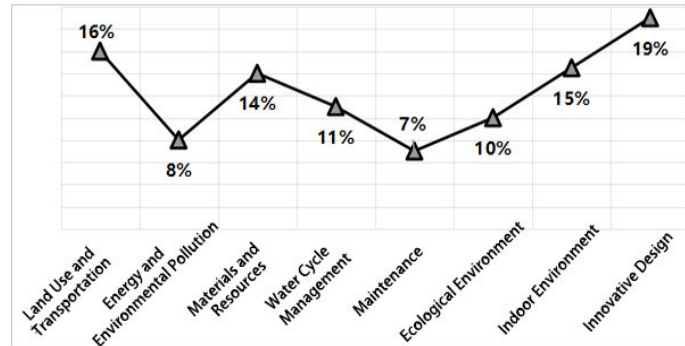


Figure 4 Weight Proportion of G-SEED Indicators

Table 1 Comparison of Evaluation System Indicators among China, Korea, and the United States

Evaluation Type	Indicator Content	ESGB	G-SEED	LEED
Location and Transportation	Sensitive Land Protection	●	●	●
	High-Priority Sites and Equitable Development	×	×	●
	Surrounding Density and Diversified Land Use	●	●	●
	Convenient Public Transportation	●	●	●
	Bicycle Facilities	●	●	●
	Reduced Parking Footprint	●	●	●
	Electric Vehicles	●	×	●
	Avoiding Excessive Underground Development	●	●	×
	Sunlight Interference Prevention Measures	●	●	×
	Accessibility of Living Facilities	●	●	×
Sustainable Sites	Construction Activity Pollution Prevention	●	●	●
	Site Assessment	●	●	●
	Habitat Protection or Restoration	●	●	●
	Site Green Space Ratio	●	●	●
	Storm water Management	●	●	●
	Heat Island Effect Mitigation	●	●	●
	Light Pollution Reduction	●	×	●
	On-site Environmental Noise Meeting Standard Requirements	●	×	×
	On-site Wind Environment Favorable for Outdoor Walking, Activity Comfort and Natural	●	●	×
	Ventilation of Buildings	●	●	●
Energy and Environmental Pollution	Energy Performance	●	●	●
	Energy Monitoring and Management Equipment	●	●	●
	Utilization of New and Renewable Energy	●	●	●
	Application of Low-Carbon Energy Technologies	●	●	●
	Ozone Layer Protection and Global Warming Mitigation	×	●	●
	Fundamental Commissioning	×	×	●
	Installation of New or Use of Existing Building-Level Energy Meters	●	-	●
	Enhanced Commissioning	×	×	●
	Advanced Energy Metering	●	×	●
	Grid Coordination	×	×	●
Materials and Resources	Use of Environmental Product Declaration (EPD)	×	●	●
	Use of Low-Carbon Materials	●	●	●
	Use of Resource Recycling Materials	×	●	●
	Use of Materials with Reduced Hazardous Substances	●	●	●
	Green Building Materials Application Ratio	●	●	●
	Installation of Recyclable Resource Storage Facilities for Household Waste	●	●	×
Water Cycle Management	Construction and Demolition Waste Management	×	×	●
	Storm water Management	●	●	●
	Utilization of Storm water and Runoff Groundwater	●	●	●
	Use of Water-Saving Fixtures	●	●	●

Table 1 Comparison of Evaluation System Indicators among China, Korea, and the United States(Continued).

Evaluation Type	Indicator Content	ESGB	G-SEED	LEED
Indoor Environment	Water Consumption Monitoring	●	●	●
	Building-Level Permanent Water Meters	×	×	●
	Application of Low-Emission Indoor Air Pollutant Products	●	●	●
	Ensuring Natural Ventilation Performance	●	●	●
	Automatic Temperature Control System Installation	●	●	×
	Lightweight Impact Sound Insulation Performance	●	●	×
	Heavyweight Impact Sound Insulation Performance	●	●	×
	Sound Transmission Performance of Inter generational Boundary Walls	●	●	×
	Traffic Noise (Highway, Railway), External Noise	●	●	×
	Restroom Plumbing Noise	●	●	×
	Environmental Tobacco Smoke Control	●	×	●
	Enhanced Indoor Air Quality Strategies	●	●	●
	Low-Emission Materials	●	●	●
	Construction Indoor Air Quality Management Plan	×	×	●
	Indoor Air Quality Assessment	●	●	●
	Thermal Comfort	●	●	●
	Indoor Lighting	●	●	●
	Quality Views	●	×	●
	Daylight	●	●	●
	Adjustable Shading Facilities	●	●	×

3.2 Rating Classification and Evaluation Methods

3.2.1 Rating Classification

ESGB is divided into Basic Level, One-Star, Two-Star, and Three-Star ratings on the basis of meeting control items. Control items are necessary conditions for green buildings. When a building project meets all control item requirements of this standard, the green building rating reaches the Basic Level. For One-Star, Two-Star, and Three-Star ratings, in addition to meeting control items, the score of each category of evaluation items should not be less than 30% of its scoring potential, with total scores corresponding to 60, 70, and 85 points respectively, and the building must be fully fitted-out and meet corresponding green building technical requirements [3].

The LEED standard adopts an indicator scoring system, with different building types having a total evaluation system score of 110 points, though the proportion of indicator scores for different evaluation contents varies across different volumes. LEED is divided into four levels: Certified 40-49 points, Silver 50-59 points, Gold 60-79 points, and Platinum 80 points and above . Among these, prerequisites do not participate in scoring and are mandatory requirements that must be met; evaluation items are calculated through cumulative scoring, with the final certification level determined by the total score [8].

G-SEED's evaluation items are divided into two types: control items and general items, where control items have minimum score requirements, and buildings applying for evaluation must obtain scores above the minimum specified for each control item. The score values corresponding to rating classifications vary for different building types [10]. Ratings are divided into four levels: Most Excellent (Green Grade 1), Excellent (Green Grade 2), Good (Green Grade 3), and Average (Green Grade 4).

Table 2 Green Rating Classification for New Buildings

Certification Level		Green Level 1	Green Level 2	Green Level 3	Green Level 4
New Buildings	Residential	Above 74 points	Above 66 points	Above 58 points	Above 50 points
	Non-residential	Above 80 points	Above 70 points	Above 60 points	Above 50 points

3.2.2 Evaluation Methods

ESGB's evaluation method includes control items and scoring items, conducting comprehensive assessments through fixed standards and quantified scoring projects. Its third-party evaluation relies on guidance from competent authorities to ensure the authority and reliability of the assessment. In terms of operation and maintenance, ESGB emphasizes the operational phase of buildings, focusing on performance and sustainability in actual use.

LEED adopts an application-review-certification process, where applicants need to submit materials and undergo review to obtain certification. Its third-party evaluation is conducted by independent institutions, ensuring objective judgment of project compliance and green standards. LEED places greater emphasis on full lifecycle management in operation and maintenance, addressing sustainability from design to use.

G-SEED similarly adopts an application-evaluation-certification process, where applicants need to submit documents

for evaluation to obtain certification. Its third-party evaluation is handled by government-designated institutions, ensuring fairness of assessment. In terms of operation and maintenance, G-SEED emphasizes long-term operation, focusing on the continuous performance and management of buildings in use to achieve long-term environmental benefits^[11], Table 3 summarizes the comparative effects through the evaluation methods of each certification system.

Table 3 Evaluation Methods of Certification Systems

Project	ESGB	LEED	G-SEED
Evaluation Method	Control Items + Scoring Items	Application—Review—Certification	Application—Assessment—Certification
Third-party Assessment	Dependent on Governing Departments	Independent Third-party Organizations	Government-designated Organizations
Operation & Maintenance	Emphasizes Operational Phase	Focuses on Full Life Cycle	Emphasizes Long-term Operation

4 Conclusion

China's Green Building Evaluation Standard GB/T 50378-2019 (2024 Edition) has played an important role in promoting green building development, but significant deficiencies remain in indicator systems, evaluation methods, and incentive mechanisms. Greater reference to advanced international experience can be made to gradually achieve alignment with international standards. Through comparative analysis with the U.S. LEED V4.0 and Korea's G-SEED, it is evident that China's green building evaluation system still has considerable room for improvement in internationalization, marketization, and refinement.

In the future, China can absorb advanced international experience while incorporating its own national conditions, constructing diversified evaluation systems according to different building types, regional characteristics, economic levels, and other factors, thereby establishing a more scientific, reasonable green building evaluation system aligned with ESGB principles. Specifically, evaluation dimensions should be expanded to introduce social and governance elements; third-party certification mechanisms should be improved to enhance standard credibility; incentive mechanisms should be strengthened to promote market orientation; dynamic update mechanisms should be enhanced to improve standard timeliness; and whole life cycle management should be strengthened to achieve sustainable development of green buildings.

About the Author

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