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Research on the Index System of Old Neighborhood Renovation Based on Green Building Evaluation Standard

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Abstract: With the advancement of the transformation, the contradiction between the residents' demand for a better living environment and the convenience of living in the settlements comes to the fore. Effective identification, organic integration, timely adoption, and correct decision-making for the transformation of old neighborhoods are pressing issues in the transformation of old neighborhoods. Therefore, this paper takes the green building evaluation standards of various countries as the research basis and support for the construction of the transformation strategy of old neighborhoods. Through the collection and comparative analysis of the indicators of green building evaluation standards, the index system of transformation is formed, and it also provides a certain foundation for the subsequent related research.

Keywords: Old neighborhoods; Green building evaluation standards; Renovation; Criteria

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1. Introduction

With urbanization, most of the old neighborhoods face the problems of inconvenient usage and incomplete transformation. It is now widely believed that the livability of settlements should include green and low-carbon, a beautiful environment, transportation access, convenient facilities, and other contents [1], transforming old neighborhoods is a key trend in urban development. Additionally, green building, which prioritizes sustainability and environmental protection, is a global concept. More countries are expected to establish green building evaluation systems. This paper uses green building standards as a reference for renovating old neighborhoods. This paper aims to analyze the essential requirements for revitalizing old neighborhoods. It also compares the weighting of scoring criteria and the similarities and differences in green building evaluation standards both domestically and internationally. By aligning with the community's needs, it proposes transformation strategies for old neighborhoods based on green building evaluation standards.

2. Retrofitting of old neighborhoods and green building evaluation criteria

2.1. Definition of old neighborhoods

According to the Guiding Opinions on Comprehensively Promoting the Renovation of Old Urban Districts issued by the General Office of the State Council, old districts refer to residential districts that were built before December 31, 2000, and are characterized by multiple features, such as serious damage to the building's structure, outdated infrastructure, poor environmental conditions, inadequate property management, and inadequate supporting public facilities. These problems have led to the inability to meet the residents' ever-increasing demand for quality of life. In summary, it is a residential district with backward public facilities that affect the basic life of the residents and a strong willingness of the residents to renovate.

2.2. Green building evaluation criteria

Currently, countries around the world are gradually raising the minimum performance standards for buildings and energy codes, focusing on reducing energy consumption and pollution of the surrounding environment during construction and use. To encourage green building design, countries have proposed corresponding green building evaluation standards. In this paper, we will focus on LEED, BREEAM, and ESGB: (1) Leadership in Energy and Environmental Design (LEED) was established and implemented by the U.S. Green Building Council and is one of the most influential and comprehensive green building evaluation indexes. (2) Building Research Establishment Environmental Assessment Method (BREEAM), the UK's Building Research Establishment Green Building Assessment System, is the first assessment system to be put into use in the world. The (3) Evaluation Standard for Green Building (ESGB) consists of five categories of indicators: safety and durability, convenient services, health and comfort, livable environment, and resource conservation.

3. Necessity and challenges of retrofitting old neighborhoods

Old neighborhoods often suffer from structural dilapidation, cracked walls, and leaking roofs, severely impacting residents' living environment and safety. Aging and damaged basic facilities like electricity, water supply, and gas pose problems such as power outages, water shortages, and safety hazards in residents' daily lives. With the dramatic increase in the number of private cars in old neighborhoods, the original design did not fully consider the parking needs of residents, and the internal road planning in old neighborhoods is unreasonable, often leading to serious traffic jams [2]. Old neighborhoods often lack professional property management teams, leading to delays in cleaning and maintenance, impacting residents' daily experiences. Therefore, these neighborhoods must be renovated in view of urbanization and the growth of public demands. However, economic benefits, energy consumption, and material conservation concerns should be taken into account during the renovation. Thus, renovating old neighborhoods poses significant challenges.

4. Application and comparison of green building evaluation standards

4.1. Application of LEED, BREEAM, and ESGB

The evaluation indicator systems are described in **Table 1**.

Table 1. Evaluation indicator systems

	LEED	BREEAM	ESGB
Evaluation categories	Integrated design (1 point)	Management (20 points/12%)	Basic score for control items (40 points)
	Site selection and transportation (9 points)	Health and well-being (22 points/15%)	Safety and durability (10 points)
	Sustainable site (9 points)	Energy (32 points/19%)	Healthy and comfortable (10 points)
	Water resource utilization efficiency (11 points)	Transportation (11 points/8%)	Convenience of life (10 points)
	Energy and atmosphere (35 points)	Water (9 points/6%)	Resource conservation (20 points)
	Materials and resources (19 points)	Materials (14 points/12.5%)	Environmentally livable (10 points)
	Indoor environmental quality (16points)	Waste (13 points/7.5%)	
	Regional priority (4 points, bonus points item)	Land and ecology (5 points/10%)	Improvement and innovation (10 points, bonus points Item)
	Design innovation (6 points, bonus points item)	Pollution (12 points/10%)	
		Innovation (10 points/10%)	

LEED evaluators can be classified as residential, commercial, office, school, healthcare, retail, data center, and warehousing based on building types. According to the building scale, it can be divided into single buildings, building groups, or communities [3]. Meanwhile, LEED evaluation indexes cover all stages of the building life cycle, including different life cycle stages such as design, construction, renovation, and operation. In addition, LEED evaluation indicators include integration process, regional priority, site selection and transportation, sustainable site, innovation, indoor environmental quality, water conservation, materials and resources, energy, and atmosphere. The BREEAM rating system can be categorized into four categories based on building type: fully-furnished buildings (except for partially-installed buildings), partially-installed buildings, shell-only buildings, and shell and core buildings. The categories of management, health and wellbeing, energy, transport, water, resource, resilience, land use and ecology, pollutants, and innovation are included (**Table 1**). The index system of the ESGB consists of the first-level indicators of safety and durability, health and comfort, convenience, resource conservation, and environmental livability. The safety and durability scoring item includes safety and durability items. The score of health and comfort includes indoor air quality, water quality, sound and light environment, indoor temperature, and humidity. Convenience score includes travel and accessibility, service facilities, intelligent operation, and property management. Resource conservation score includes four aspects: land use, energy conservation, water use, and building materials. The score for environmental livability includes site ecology and landscape and outdoor physical environment.

4.2. Comparison of LEED, BREEAM, and ESGB

While all emphasize resource conservation, BREEAM, and LEED stand out for their comprehensive coverage of a building's entire life cycle, while ESGB focuses on the planning and design, construction, operation, and maintenance phases of a building [4]. LEED checks building setups to cut energy use and shift away from non-renewable power. BREEAM prioritizes energy reduction via tech and design, promoting solar energy solutions. ESGB covers land, energy, water, and materials. LEED stresses sustainable land use, ESGB focuses on residential land quality, and BREEAM highlights green spaces. ESGB sets high water conservation standards, including detailed assessments of appliances and landscape irrigation. In terms of material saving, ESGB emphasizes the use of intensive production, reducing the amount of materials used and the use of materials

that have a low impact on the surrounding environment, whereas LEED classifies and recycles materials, and BREEAM advocates the use of reuse and recycling facilities [5].

LEED, BREEAM, and ESGB prioritize health and comfort in older neighborhood renovations. ESGB has detailed standards for daylight, window placement, noise, air circulation, and indoor air quality, including natural lighting, temperature control, and air quality monitoring. BREEAM focuses on lighting, ventilation, recreational spaces, and gas concentration monitoring. LEED monitors carbon dioxide for ventilation and encourages low-emission materials, with mandatory daylighting rules. ESGB focuses on improving accessibility amenities for people with disabilities, such as entrances, elevators, and restrooms. ESGB also emphasizes the optimization of indoor services, such as the clarity of information instructions, easy access to emergency services, and the comfort and multi-functionality of leisure spaces. [6]

4.3. Reasons for the differences in scoring items between LEED, BREEAM, and ESGB

LEED, BREEAM, and ESGB prioritize health and comfort in renovating old neighborhoods. ESGB specifies standards for daylight, window placement, noise, air circulation, and indoor air quality, including natural lighting, temperature control, and air quality monitoring. BREEAM emphasizes lighting, ventilation, recreational spaces, and gas concentration monitoring. LEED tracks carbon dioxide levels for ventilation and promotes low-emission materials, with mandatory daylighting standards.

5. Research on retrofitting indicators for old neighborhoods based on green building evaluation standards

5.1. Current situation and needs of old neighborhoods renovation

Residents in older neighborhoods are primarily elderly, and most of the houses in these areas are aging. Common issues include poor thermal insulation, roof leaks, poor sanitation, and general inconvenience, which fail to meet the basic needs of the elderly and make it challenging to ensure a high quality of life for them. Moreover, outdated community pipelines and improper pipeline layouts necessitate a comprehensive upgrade. Residents also believe that their communities suffer from significant damage to the base of the building walls due to water infiltration and urgently need exterior wall repairs [8]. Furthermore, entrance ramps, stair railings, elevators, and transportation facilities in these neighborhoods are often in disrepair or completely absent. Additionally, outdoor recreation areas, waste recycling and disposal systems, and indoor environmental upgrades should be considered in the renewal and reconstruction of these communities.

In response to the demand for modernization and renovation of old neighborhoods, the following aspects can be addressed: upgrading facilities and equipment, enhancing transportation accessibility, expanding service facilities, improving the external environment, optimizing building facades, establishing effective community management, and enhancing waste disposal efficiency (**Table 2**).

Table 2. Indicator content based on the needs of old neighborhoods

Serial number	Content of the indicators	Specific measures
1	Modernization of facilities and equipment	Upgrading and modernization of equipment
2	Functionality	Transportation accessibility
		Service facility additions
3	Improved external environment	Roads and lighting
		Parking Conversion

Table 2 (Continued)

Serial number	Content of the indicators	Specific measures
4	Elevation and façade remodeling	Repair of external walls
		Shading and ventilation design optimization
6	Community management and services	Structuring the community management system
7	Well-equipped recreational facilities	Construction of refurbished outdoor recreational facilities
8	Waste recycling and disposal	Improvement of waste separation and recycling system

5.2. Evaluation indicators for retrofitting old neighborhoods based on green building evaluation standards

Based on the above analysis of the current situation in old neighborhoods, a comparative study of the scoring items of green building evaluation standards both domestically and internationally was conducted. This led to the proposal of evaluation indexes specifically applicable to the renovation of old neighborhood (**Table 3**).

Table 3. Content of indicators for the assessment of old neighborhoods

Serial number	Primary indicators	Secondary indicators
1	Environmental quality assessment: indoor environmental quality	Air quality
		Light conditions
		Temperature and humidity control
		Noise situation
		Interior Layout Design
2	Environmental quality assessment: outdoor environmental quality	Green landscape
		Utility
3	Transportation assessment	Traffic organization in and around old neighborhoods
		Road facilities
		Traffic sign
		Public transportation services
		Barrier-free
4	Assessment of energy efficiency in buildings	Energy consumption
		Equipment efficiency
		Insulate
		Day lighting
		Water conservation
		Energy use structure
		Design and operation of energy-using systems
5	Material selection and recycling assessment	Sources of materials
		Production process
		Renewability
		Feasibility and benefits of utilization and recycling

5.2.1. Environmental quality assessment

(1) Indoor environmental quality

The indoor environmental quality assessment evaluates the comfort, health, and functionality of interior spaces in old neighborhoods during renovation projects. It considers air quality, lighting, temperature, humidity control, noise levels, and interior design. Improving indoor quality in old neighborhoods aims to enhance residents' comfort and health.

(2) Outdoor environmental quality

The outdoor environmental quality assessment, an integral part of renovations in aging neighborhoods, meticulously examines indoor spaces to ensure comfort, health, and functionality are prioritized. This assessment delves into air quality, lighting, temperature, humidity, noise control, and design elements, all with the overarching objective of significantly enhancing residents' well-being and living experience.

5.2.2. Transportation assessment

The traffic quality assessment for old neighborhood renovations involves evaluating traffic organization, road facilities, signs, and nearby public transport. Improvement plans aim to enhance residents' travel convenience, safety, and comfort by addressing traffic flow, parking, and access for walking and cycling. Accessibility indicators are essential. Better transportation in old neighborhoods fosters a more livable environment for residents.

5.2.3. Assessment of energy efficiency in buildings

Assessing energy efficiency in older districts involves evaluating building energy usage, equipment efficiency, insulation, lighting, water and electricity conservation, as well as energy sources, usage structure, and system design. The goal is to identify and address energy efficiency issues in buildings.

5.2.4. Material selection and recycling assessment

The evaluation of material selection and recycling for old district renovation involves a meticulous examination of sustainability and recyclability potential. It encompasses detailed analyses of material origins, production methods, renewable characteristics, and energy demands, alongside assessing the viability and benefits of repurposing existing materials.

6. Summary

This study thoroughly examines the typical conditions of old neighborhoods, identifying their deficiencies and the needs of residents. It also compares domestic and international green building evaluation standards, analyzing their similarities and differences and understanding the reasons behind them. By combining the current state of old neighborhoods with the requirements of green building evaluation standards, the study derives evaluation indices for neighborhood renovation. These indices include assessments of environmental quality, transportation, building energy efficiency, and material selection and recycling, providing a foundation for future research.

Disclosure statement

The author declares no conflict of interest.

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