

Research on the Optimization of Interior Design for Green Smart Residential Buildings from the Perspective of High-quality Human Settlements

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Abstract

Against the background of the transformation and upgrading of China's housing industry and the "Dual Carbon" strategy, the Ministry of Housing and Urban-Rural Development has advocated the construction of high-quality residential buildings with safety, comfort, green development and smart technology. Conventional residential interior design merely focuses on visual aesthetics, while systematic ecological planning and integrated intelligent control are often neglected. Taking high-quality human settlement as the starting point, this paper follows the dual development goals of improving people's livelihood and upgrading the construction industry. It identifies diversified residential demands in the new era and establishes an integrated design framework combining low-carbon green technology and smart human settlement systems. Optimization strategies are put forward in three aspects: spatial functional layout, ecological environment construction and whole-house intelligent linkage. Finally, this paper summarizes the upgrading trend of contemporary residential interior design. The research conclusions can provide theoretical support for the refined decoration of commercial housing and indemnificatory housing, and promote the popularization of green and smart residential projects.

Keywords

High-quality human settlements, green smart residence, interior design, low-carbon renovation, smart home.

1. Introduction

China's urban housing construction has shifted from large-scale incremental development to quality improvement. Housing supply is no longer limited to basic living functions, but focuses on creating high-quality living scenarios. The Ministry of Housing and Urban-Rural Development has launched the high-quality "good housing" campaign, taking low-carbon development, intelligent management, living safety and environmental comfort as core evaluation criteria, so as to transform residential buildings from physical shelters into healthy living spaces [1].

At present, two major problems exist in domestic residential interior design. First, most green design measures remain superficial, including indoor greening and the selection of environment-friendly boards. Systematic ecological design such as building energy conservation, natural ventilation and pollution prevention is insufficient. Second, smart home products are installed separately. Lighting, security, heating and environmental monitoring systems operate independently without interconnection. Green technology and intelligent equipment fail to form synergies. Meanwhile, family diversification brings new demands including multi-functional space, healthy microenvironment and remote household management.

On this basis, guided by high-quality human settlement requirements and national strategies, this paper carries out research on residential demand analysis, design concept reconstruction, integrated design strategies and industrial upgrading trend, so as to form systematic optimization schemes for interior refined decoration of green smart residences.

2. Research Value of the Topic

2.1. Policy Value

This research conforms to the national deployment of high-quality housing construction. The series of industrial codes issued by the Ministry of Housing and Urban-Rural Development set strict requirements for residential energy conservation, indoor pollution control and intelligent renovation. This study integrates low-carbon technology and smart systems into the whole process of interior design, and solves the long-standing problem that green design is only applied to building facades rather than interior decoration [2]. It helps achieve the carbon reduction goal throughout the building life cycle and keeps pace with the high-quality development of the housing industry.

2.2. People's Livelihood Value

Residents' demands have shifted from basic housing to high-quality living experience. Apart from spatial pattern and decoration style, households pay more attention to air quality, temperature control, noise isolation and home security. Integrated green and smart interior design effectively solves common living problems such as formaldehyde pollution, excessive energy consumption and complicated household management [3]. It continuously improves urban living quality and meets the social demand of people's livelihood improvement.

2.3. Industrial Value

The traditional home decoration industry is featured with extensive construction, material waste and random equipment installation. This research constructs an integrated design system including eco-friendly materials, passive energy-saving structures and whole-house intelligent control. It promotes the transformation of interior design from fragmented decoration to systematic overall planning, accelerates the green, digital and refined upgrading of the home decoration industry, and drives the industrial chain development of high-quality residential refined decoration.

3. Core Human Settlement Demands of High-Quality Residences in the New Era

3.1. Flexible Functional Demands for Diversified Family Structures

Family composition has become increasingly diversified, including young singles, nuclear families, multi-generational families and people working from home. Fixed spatial division cannot adapt to dynamic life scenarios. High-quality residential interior space needs modular and flexible layout: the living room can serve reception and parent-child activities; the study can be transformed into a home office; barrier-free passages and emergency call devices are equipped in bedrooms for the elderly. Multi-scene utilization has become the basic requirement of modern housing.

3.2. Ecological Health Demands for Low-Pollution Indoor Microenvironment

Indoor health has become the primary index of human settlement evaluation. Residents put forward three major ecological requirements: first, air quality control. Pollutant release from plates and coatings should be strictly limited, and natural ventilation should be optimized to reduce harmful gas concentration in closed rooms. Second, thermal comfort. Insulation and

sunshade structures can cut down the operating load of air conditioning and heating equipment. Third, resource conservation. Water recycling and water-saving appliances are applied to realize low-carbon indoor operation, which is the core pursuit of high-quality green human settlement construction[4].

3.3. Intelligent Demands for Automatic Whole-House Management

Residents expect interconnection of household equipment rather than scattered smart devices. The lighting, fresh air system, heating equipment, doors and security system need centralized management with one-click scene switching and remote mobile control. Automatic mode will cut off power supply and close windows when residents leave home, which has become a standard configuration of high-quality housing.

3.4. Safety and Durability Demands

High-quality human settlement also includes living safety. Flame-retardant building materials are adopted for wall, floor and cabinet decoration; water and electricity pipelines are laid in concealed ways to avoid potential risks. Durable decoration structures reduce frequent renovation and resource waste, which matches the long-term usage requirement of green buildings.

4. Integrated Design Concept of Low-Carbon Green Development and Intelligent Empowerment

4.1. Core Connotation

The fundamental principle is prioritizing passive ecological design supplemented by active intelligent control. Natural ventilation, daylighting optimization and environment-friendly materials are adopted first to cut down indoor energy consumption and pollution. Then the whole-house intelligent system carries out refined environmental regulation to avoid excessive energy consumption caused by blind stacking of electrical equipment. Spatial function, ecological environment and intelligent system should be planned as a whole instead of being separated from each other.

4.2. Low-Carbon Green Design Logic

Passive energy conservation takes precedence over active emission reduction. The green design focuses on structural optimization rather than simple indoor planting. Reasonable window layout forms cross ventilation to reduce the running time of fresh air equipment; low-VOC coatings and E0-grade plates are selected to control pollution at the source; sunshade and thermal insulation structures reduce the load of heating and cooling facilities. Natural ecological measures form the foundation of healthy living space.

4.3. Intelligent Design Logic

The whole-house smart system follows interconnection and scene-based control to avoid redundant equipment. All sensors, ventilation equipment and lighting devices are connected to a unified intelligent gateway. The system automatically adjusts equipment operation according to real-time monitoring data of temperature, humidity and air quality. Multiple independent control applications are eliminated to simplify circuit layout and save energy.

4.4. Synergy between Green Design and Smart Technology

Intelligent sensors provide data support for energy-saving operation, which further improves the low-carbon effect of green structures. Meanwhile, sufficient natural daylight and ventilation reduce the working frequency of electrical equipment. Ecological construction improves living environment, and intelligent technology realizes precise energy management. The two parts coordinate with each other to build low-carbon human settlements [5].

5. Integrated Optimization Strategies for Green Smart Residential Interior Design

5.1. Integrated Functional Space: Constructing Modular and Compound Living Scenarios

First, apply movable spatial partition. Light partition walls and sliding doors replace solid brick walls to realize flexible space reconstruction. Multi-functional cabinets integrate storage and partition functions, which are convenient for scene switching between office, leisure and accommodation. Light steel keel gypsum board is adopted for partition walls to reduce construction waste and pollution [6].

Second, integrate pipeline and cabinet design. Circuits for water supply, power supply and intelligent sensing are pre-buried inside walls and ceilings. Storage cabinets are designed to wrap pipelines uniformly, reducing secondary material cutting and decoration garbage [7].

5.2. Integrated Ecological Environment: Establishing Full-Process Indoor Pollution and Energy Control System

First, strictly control the environmental performance of building materials. All hard decoration materials are selected from national green building material catalogs, including E0 wood panels, inorganic water-based paint and environment-friendly floor materials. Complicated ceiling and multi-layer decorative walls are simplified to reduce the total consumption of construction materials.

Second, optimize natural ventilation and daylighting. Furniture layout will not block windows to form stable cross ventilation. Light-colored wall and reflective materials are used in poorly lit rooms to make full use of natural light and shorten daily lighting hours.

Third, set up simple water recycling facilities and native indoor plants to purify air and optimize microclimate at low cost.

5.3. Integrated Intelligent System: Building Linked Whole-House Control Network

First, build a unified hardware network based on intelligent gateway. Air quality sensors, temperature probes, door and window detectors are connected to the same control system, realizing data interconnection of all equipment. Real-time environmental monitoring provides basis for automatic equipment operation.

Second, preset multiple automatic operation modes including leaving home, daily living, sleeping and receiving guests. The system will cut off idle power supply and adjust ventilation and lighting intelligently according to indoor environmental indexes.

Third, control the total number of intelligent hardware. Low-power wiring and automatic power-off programs are adopted to prevent the intelligent system itself from causing extra energy consumption [8].

6. Upgrading Trend of Contemporary Residential Interior Design

6.1. Transformation of Design Mode

The traditional decorative design focusing on appearance will be replaced by systematic integrated planning. Spatial layout, ecological structure and intelligent circuit design will be completed simultaneously in the preliminary scheme phase, so as to avoid repeated reconstruction caused by separated design of hard decoration and smart equipment.

6.2. Adjustment of Technical Route

Passive energy-saving technologies such as natural ventilation and daylighting will become the primary choice of green design. Intelligent equipment only serves as auxiliary regulation means. The industry will abandon the high-energy consumption mode relying on large quantities of electrical appliances and return to low-carbon ecological construction.

6.3. Popularization of Standardized Refined Decoration

Green smart interior design will expand from high-end commercial housing to ordinary commodity housing and indemnificatory rental housing. Modular standardized decoration packages will be formulated, with unified environment-friendly material list and basic intelligent configuration. High-quality healthy living space will be available for more residents under cost control.

6.4. Improvement of Evaluation Standards

Future acceptance standards will add quantitative indexes including indoor pollutant concentration, daily energy consumption and intelligent linkage efficiency, instead of only checking construction appearance. Health performance, carbon emission level and intelligent operation effect will become core evaluation criteria for high-quality residential interior design.

7. Conclusion

The national high-quality "good housing" campaign has opened up a new track of green, healthy and intelligent development for residential interior design. Faced with diversified human settlement demands, designers need to break the limitation of pure decorative design and take high-quality living experience as the core theme. It is essential to integrate low-carbon ecological construction technology and whole-house intelligent control system into interior planning.

This paper analyzes residential demands in the new era, constructs the integrated design concept of green development and intelligent empowerment, and puts forward targeted optimization strategies in spatial layout, ecological construction and smart system. It clarifies the development trend that residential interior design shifts from visual decoration to systematic low-carbon healthy construction. Driven by the "Dual Carbon" goal and housing quality upgrading policy, integrated green and smart design will become the mainstream scheme of high-quality residential refined decoration, and continuously promote people's livelihood improvement and the green digital transformation of the home decoration industry.

References

- [1] Ministry of Housing and Urban-Rural Development of the People's Republic of China. (2019). Evaluation standard for green building: GB/T 50378-2019. China Architecture & Building Press.
- [2] Wu, Y. (2023). Practical integration path of green building concept based on fully-decorated residential design. *Research of Architectural Science and Engineering*, 5(11), 89–92.
- [3] Wang, Y., & Zhang, L. (2023). High-quality human settlement construction and low-carbon interior renovation strategy of urban residence. *Journal of Sustainable Architecture and Civil Engineering*, 19(2), 45–51.
- [4] Ou, W. L. (2024). Research on green intelligent design and human settlement environment optimization of high-quality residential buildings. *Low Carbon World*, 14(12), 67–69.
- [5] Brown, K. (2023). Intelligent empowerment and ecological optimization of residential interior design under dual-carbon background. In *2023 International Symposium on Low-Carbon Urban Construction* (pp. 208–213).

- [6] Yan, Z. P. (2024). Application of green building design concept in the optimization of residential interior space. *Development Orientation of Building Materials*, 22(6), 53–55.
- [7] Zhang, L. J. (2023). Integrated interior design strategy of prefabricated smart residences under the dual-carbon goal. *China Construction Metal Structure*, 22(12), 124–126.
- [8] Smith, J., & Lee, H. (2024). Research on green and intelligent optimization design of modern residential interior space. In *Proceedings of 2024 International Conference on Green Building and Smart Civil Engineering* (pp. 112–117).