

Research on Sustainable Development Strategies of New Construction Techniques in Civil Engineering under the New Real Estate Development Model

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Abstract: *In the context of the growing global emphasis on sustainable development, the construction industry, particularly the field of civil engineering construction, is facing unprecedented challenges and opportunities. Under the new real estate development model, traditional construction techniques can no longer meet the increasingly stringent environmental requirements and market demands. Therefore, exploring sustainable development strategies for new construction techniques in civil engineering is of great significance. This paper first outlines the application of sustainable development in the construction industry, specifically in civil engineering construction. It analyzes the main challenges faced by construction techniques under the new real estate development model. The focus then shifts to the introduction and innovation of new techniques, sustainable development technical strategies, and comprehensive management strategies, aiming to provide references and guidance for the industry's development. The research indicates that adopting innovative construction techniques and comprehensive management strategies not only enhances project quality and efficiency but also effectively reduces environmental impact, achieving sustainable development goals.*

Keywords: *New Real Estate Development Model, Civil Engineering, Construction Techniques, Sustainable Development, Innovative Strategies*

1. Introduction

As global environmental issues become increasingly severe and the concept of sustainable development gains popularity, the construction industry, known for its significant resource consumption and environmental impact, faces tremendous pressure to transform. Especially under the new economic conditions and policy environment, the real estate market's development model is constantly adjusting, driving the need for innovation and optimization in civil engineering construction techniques to meet new demands

Research Significance:

The new real estate development model emphasizes high efficiency, green, and intelligent development, imposing higher demands on civil engineering construction techniques. Researching sustainable development strategies for new techniques not only helps to improve construction quality and efficiency but also reduces resource consumption and environmental impact, providing a scientific basis for achieving sustainable development in the industry.

Research Necessity:

Traditional civil engineering construction techniques struggle to cope with the current complex and changing market demands and stringent environmental standards. There is an urgent need to explore construction techniques that adapt to the development of new models through technological innovation and management optimization, ensuring that project construction achieves a balance between environmental, economic, and social benefits. Therefore, conducting relevant research holds significant practical importance and urgency.

2. Application of Sustainable Development in Civil Engineering Construction

2.1 Overview of Sustainable Development

Sustainable development refers to a mode of development that meets current needs without compromising the ability of future generations to meet their own needs. Its core concept revolves around balancing and harmonizing economic growth, social progress, and environmental protection. In the construction industry, especially in civil engineering, implementing sustainable development aims to drive the sector's green transformation by optimizing resource utilization, reducing environmental pollution, and improving energy efficiency.

Globally, the principle of sustainable development has become a crucial guiding principle for the construction industry. Many countries have introduced policies and regulations to promote the construction of green and low-carbon buildings. For instance, the promotion of green building certification systems like LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Method) provides specific implementation standards and evaluation systems for the sustainable development of the construction industry^[1].

China has also made significant progress in sustainable development. The issuance of regulations such as the "Green Building Evaluation Standard" and "Building Energy Efficiency Design Standard" offers policy support for the sustainable development of civil engineering. Simultaneously, the government encourages and supports the research and application of new technologies and materials, such as solar energy utilization technology and Building Information Modeling (BIM), to promote the sustainable development of the construction industry.

2.2 Specific Applications of Sustainable Development in Civil Engineering Construction

The application of sustainable development concepts in civil engineering construction is mainly reflected in the following aspects:

2.2.1 Selection and Application of Green Building Materials

Green building materials are those that have minimal environmental impact during their production, use, and disposal. In civil engineering construction, selecting and using green building materials, such as recycled concrete, low-carbon cement, and renewable timber, can reduce the consumption of natural resources and lower carbon emissions during construction. For example, using recycled concrete can decrease the exploitation of natural aggregates and reuse construction waste, reducing the burden of waste disposal.

2.2.2 Resource Conservation and Waste Management Strategies

Efficient utilization of resources and waste management during civil engineering construction are key to achieving sustainable development. Optimizing construction processes and using high-efficiency construction equipment and technologies can maximize resource conservation. Implementing strict waste management measures, such as waste sorting and recycling, can minimize environmental pollution. Construction sites should establish dedicated waste sorting and recycling stations to handle and repurpose waste scientifically^[2].

2.2.3 Efficient Energy Use and Integration of Renewable Energy

Enhancing energy efficiency and promoting the use of renewable energy are vital pathways to achieving sustainable development in civil engineering construction. Using energy-efficient construction equipment and optimizing electricity management on construction sites can reduce energy consumption. Additionally, promoting the use of renewable energy sources such as solar and wind power in construction, like solar water heating systems and wind power generation devices, can decrease reliance on traditional energy sources and reduce carbon emissions during construction.

2.2.4 Low-Carbon Construction Techniques

Low-carbon construction techniques aim to reduce carbon emissions and energy consumption during construction. For example, employing prefabricated construction techniques can reduce on-site wet work, thereby lowering energy consumption and carbon emissions during construction. Moreover, prefabricated construction can enhance construction efficiency, shorten project timelines, and reduce overall project costs^[3].

2.2.5 Application of Building Information Modeling (BIM)

Building Information Modeling (BIM) is a crucial tool for achieving sustainable development in civil engineering construction. BIM technology creates a digital model of buildings, allowing for the simulation and optimization of the construction process. This improves construction efficiency and reduces resource waste and environmental pollution. Additionally, BIM supports lifecycle management, optimizing the design, construction, and maintenance of buildings, furthering sustainable development goals.

3. Challenges of New Construction Techniques in Civil Engineering under the New Real Estate Development Model

3.1 Background and Characteristics of the New Real Estate Development Model

In recent years, global economic conditions and technological advancements have driven continuous changes in the development model of the real estate industry, forming a new development model characterized by efficiency, greenness, and intelligence. The real estate market has diversified beyond residential development to include commercial complexes, smart communities, and green buildings. Concurrently, policy regulations, market demand changes, and technological innovations compel real estate companies to continually adjust their strategies to adapt to the new market environment.

Policy Background: Governments have introduced various policies to promote green transformation and high-quality development in the real estate industry. For instance, policies on green building evaluation and the promotion of prefabricated buildings encourage real estate companies to adopt sustainable development principles, enhancing building quality and energy efficiency.

Market Demand: Consumers' expectations for living environments are rising, with increased attention to comfort, health, and smart features in living spaces. Therefore, real estate developers need to incorporate more innovative elements into their designs and construction processes to meet market demands.

Technological Advancements: The application of emerging technologies such as information technology, IoT, and big data in real estate development is deepening. The use of intelligent buildings, digital construction management, and green building materials makes real estate project development more efficient and sustainable^[4].

3.2 Major Challenges Faced by Civil Engineering Construction Techniques

Under the new real estate development model, civil engineering construction techniques face challenges in multiple areas. These challenges primarily involve increased complexity of techniques, environmental requirements, cost control, and timeline management.

Increased Complexity of Techniques: With the diversification of building functions and forms, construction techniques are becoming more complex. The construction of multifunctional complexes, high-rise buildings, and prefabricated structures requires the integration of various new technologies and processes, increasing technical difficulty and management complexity.

Enhanced Environmental Requirements: Real estate development under the new model places greater emphasis on environmental protection, necessitating compliance with stringent environmental standards during construction. Reducing carbon emissions, conserving energy, and managing construction waste are critical issues that construction techniques must address.

Cost Control Pressure: With intensified market competition and heightened environmental requirements, controlling construction costs becomes increasingly challenging. Effective cost management while ensuring construction quality and meeting environmental standards is a significant challenge for construction techniques.

Timeline Management Difficulty: Rapid changes in market demand lead to high expectations for project delivery times from developers. The complexity of construction techniques and stringent environmental standards make timeline management more difficult. Efficiently completing construction tasks within limited timeframes tests the capabilities of construction management teams.

3.3 Technical Challenges in Construction Techniques

To address the aforementioned challenges, civil engineering construction techniques must overcome various technical difficulties. These difficulties relate to the construction of complex structures, the application of high-performance materials, and the operation of new construction equipment.

Construction of Complex Structures: High-rise buildings and complex structural buildings pose higher requirements for construction techniques. For example, constructing large-span structures and high-rise steel structures demands precise measurement and installation techniques, as well as robust technical support and construction experience^[5].

Application and Construction of High-Performance Materials: New high-performance materials, such as ultra-high-performance concrete and carbon fiber-reinforced composites, offer superior properties but involve complex construction processes. Strict control over material ratios, temperature, and humidity parameters during construction is necessary to ensure quality.

Operation and Maintenance of New Construction Equipment: Automated and intelligent construction equipment, such as smart robots and 3D printers, can enhance construction efficiency but require high skill levels for operators. Additionally, the daily maintenance and servicing of this equipment require professional technical support to ensure normal operation and construction quality.

3.4 Challenges in Human Resources and Skill Requirements

Under the new real estate development model, civil engineering construction demands higher standards for human resources and skills. Challenges include a shortage of skilled workers, inadequate professional skill training, and the need to enhance the comprehensive qualities of management personnel.

Shortage of Skilled Workers: The increasing complexity of construction techniques drives demand for highly skilled technical workers. However, there is a widespread shortage of skilled workers in the construction industry, making it difficult to meet the requirements for high-tech construction.

Need for Professional Skill Training: The promotion and application of new techniques and technologies require systematic professional skill training for construction personnel. Currently, there is insufficient investment in skill training within construction companies, leading to a gap between the skills of construction personnel and the requirements of new techniques.

Enhancing Comprehensive Qualities of Management Personnel: The management of construction under the new model requires managers to possess higher comprehensive qualities, including project management capabilities, technological innovation abilities, and environmental awareness. Therefore, construction companies must focus on training management personnel to enhance their ability to cope with complex construction environments.

4. Sustainable Development Strategies for New Construction Techniques in Civil Engineering under the New Real Estate Development Model

4.1 Introduction and Innovation of New Techniques

In the context of the new real estate development model, the introduction and innovation of construction techniques are crucial for enhancing project quality and efficiency, and achieving sustainable development. The key areas for introducing and innovating new techniques include:

4.1.1 Prefabricated Construction Technology

Prefabricated construction technology involves manufacturing building components in a factory setting, which are then transported to the construction site for assembly. This significantly reduces on-site wet work and improves construction efficiency and quality. Prefabricated construction not only minimizes construction waste and resource consumption but also effectively reduces the impact on the surrounding environment. This technology holds broad application prospects in high-rise buildings, commercial complexes, and residential projects^[6].

4.1.2 Modular Construction Technology

Modular construction involves breaking down buildings into multiple modules, which are manufactured and decorated internally in a factory, then transported to the site for assembly. Modular construction technology offers advantages such as shortening construction periods, lowering construction costs, and improving construction quality. It is suitable for various types of building projects, especially those requiring quick delivery, where it shows significant benefits.

4.1.3 3D Printing Construction Technology

3D printing construction technology uses 3D printing equipment to directly print building components or entire structures by adding material layer by layer. This method achieves efficient and precise construction. It not only reduces material waste but also allows for flexible adjustments to component shapes based on design needs, meeting the demands for personalized and customized construction. This technology fosters innovation in building design and construction.

4.1.4 Intelligent Construction Robots

Intelligent construction robots, such as bricklaying robots, spraying robots, and welding robots, significantly enhance construction efficiency and quality, while reducing labor costs and construction risks. These smart devices exhibit advantages that are difficult to match with traditional construction methods, particularly in complex and hazardous construction environments.

4.2 Technical Strategies for Sustainable Development

Building on the introduction and innovation of new techniques, implementing technical strategies for sustainable development is vital for driving the green transformation of the construction industry. Specific strategies include:

4.2.1 Green Construction Techniques

Green construction techniques emphasize environmental protection and resource conservation during the construction process. This includes using environmentally friendly building materials, managing construction waste, and conserving energy. Promoting the use of eco-friendly building materials and adopting energy-saving technologies, such as solar photovoltaic panels and rainwater collection systems, can effectively reduce carbon emissions and resource consumption during construction.

4.2.2 Resource Recycling Technologies

Resource recycling technologies aim to minimize resource waste and environmental pollution by recycling and reusing construction waste. For example, processing and crushing demolished concrete to produce recycled aggregates for new building materials reduces waste accumulation and conserves natural resources.

4.2.3 Low-Energy Consumption Construction Methods

Low-energy consumption construction methods focus on optimizing construction processes and technologies to reduce energy consumption during construction. This involves using energy-efficient construction equipment and machinery, optimizing construction workflows and site management to minimize unnecessary energy waste. Promoting the use of renewable energy sources, such as solar and wind energy, instead of traditional fossil fuels, further reduces the carbon footprint of construction activities.

4.3 Comprehensive Management Strategies

To ensure the effective implementation of new techniques and sustainable development strategies, comprehensive management strategies are essential. These strategies encompass lifecycle management, quality management systems, and information management:

4.3.1 Lifecycle Management

Lifecycle management emphasizes managing and optimizing the entire project process, from planning, design, and construction to operation and maintenance. By adopting Building Information Modeling (BIM) technology, information sharing and collaborative management across all stages can be achieved, improving work efficiency and coordination, ensuring project sustainability and effectiveness.

4.3.2 Quality Management System

Establishing a robust quality management system ensures the standardization and normalization of construction techniques and technologies. By setting strict construction standards and quality control measures, and conducting regular inspections and evaluations, each stage of the construction process can be ensured to meet design requirements and quality standards, improving overall construction quality and performance.

4.3.3 Information Management

Information management involves introducing Project Management Information Systems (PMIS) to achieve digital and intelligent management of the construction process. Real-time monitoring of

construction progress, resource allocation, and quality status helps in promptly identifying and resolving issues, enhancing the transparency and efficiency of construction management. Additionally, using big data analytics and intelligent decision support systems can optimize construction plans and resource allocation, promoting scientific management and efficient construction.

5. Conclusion

In summary, the sustainable development strategies for new construction techniques in civil engineering under the new real estate development model involve the introduction and innovation of new techniques, the implementation of sustainable technical strategies, and comprehensive management strategies. These approaches can effectively enhance project quality and efficiency, reduce environmental impact, and achieve the green transformation and sustainable development of the construction industry. This requires not only technical innovation but also optimization of management models and policy support to jointly drive high-quality development in the construction industry.

This paper deeply analyzes the challenges and technical difficulties faced by construction techniques in civil engineering under the new real estate development model and proposes a series of sustainable development strategies. The main conclusions are as follows:

Introduction and Innovation of New Techniques: Introducing advanced construction technologies and materials, such as prefabricated and modular construction, can significantly improve project efficiency and quality while reducing resource waste and environmental pollution during construction.

Sustainable Development Technical Strategies: Adopting green construction techniques and low-energy consumption methods, such as utilizing renewable energy like solar and wind power and recycling construction waste, markedly lowers the negative environmental impact of construction.

Comprehensive Management Strategies: Implementing lifecycle management and quality management systems, and utilizing information management tools, increases project management efficiency, ensuring the green and efficient execution of the entire construction process.

Future Directions: Future research should further explore the applicability and promotion pathways of new techniques across different types of projects, particularly in the areas of policy support and industry standardization. Additionally, enhancing international cooperation and exchanges to learn from advanced global experiences will drive the continuous innovation and optimization of civil engineering construction techniques in China, supporting the sustainable development of the construction industry.

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