Construction and Application of the Green Construction Management Process Model: A Case Study of the JD Project

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Abstract: With the introduction of the "dual carbon" targets, the construction industry is facing unprecedented challenges and opportunities. The goals of carbon peak and carbon neutrality drive the green and industrialized development of the industry, requiring adjustments to project management models and processes. The traditional green building management model, which is centered around the construction unit, needs to be changed to a more systematic, full-lifecycle approach for better efficiency in green construction management. This paper follows a research logic of "logical analysis - problem identification - application needs - model construction - practical application - optimization", taking a JD hotel project in Hainan as a case study. It explores the optimization path of green construction management processes and proposes a multi-organizational collaborative green construction management model, emphasizing full participation throughout the "design, planning, construction, and usage" phases. By comparing with traditional management models, a cross-organizational collaborative green construction management model and process are established, making green construction management more precise, environmentally friendly, and sustainable, thus providing practical experience and theoretical references for the green transformation of the construction industry.

Keywords: Green Construction; Management; Process Optimization; Organizational Collaboration

1. Introduction

The construction industry is currently facing issues such as long management chains, numerous stages, and difficulties in precise management. This is particularly true for existing buildings, which often exhibit high energy consumption and emissions during their operation. Additionally, the large stock of buildings and the high proportion of carbon emissions during the operational phase severely restrict the sustainable development of the industry [1]. Under the guidance of the "dual carbon" goals, the construction industry is facing an urgent need for transformation. The goals of carbon peak and carbon neutrality have driven the processes of green building and industrialization, requiring the industry to adopt more efficient management models and technologies to achieve a balance between resource conservation and environmental protection [2]. As a key pathway for promoting the transformation of the construction industry, green construction aims to achieve coordinated development of resource conservation, environmental protection, and high efficiency through technological innovation and scientific management, in line with the requirements of green development [3]. However, with the continuous improvement of green construction management requirements, the traditional "construction unit-centered green construction management" model is no longer suitable for the demands of the new situation. The push for green, full-process, and systematic project management has become more urgent, and the industry urgently needs to transition to a "multidimensional cross-disciplinary management process optimization based on the entire process of planning, design, construction, and operation."

2. Background

Green construction, as a core strategy for promoting sustainable development in the construction industry, includes energy-saving, environmental protection, and low-carbon management throughout the entire lifecycle of buildings. With the introduction

of the "dual carbon" goals, research related to green construction has gradually become a key focus within the industry [4]. Current studies mainly concentrate on specific aspects such as green design, green construction technologies, and green procurement, proposing various technological innovations for these stages. However, the majority of research focuses on the application of green technologies within individual stages, with little attention paid to the synergistic effects between different stages and the optimization of full-process management [5]. Traditional green construction management models tend to be centered on the construction unit, lacking a comprehensive perspective on lifecycle management. As a result, collaboration between stages is insufficient, and the expected benefits of green construction are not fully realized.

In terms of optimizing green construction management processes, while existing research has proposed methods such as lean construction and full-process management, most remain at the theoretical level, lacking concrete practical applications and empirical support. In particular, existing studies have not yet explored in depth the role of multi-organizational collaboration and cross-departmental cooperation in enhancing the efficiency and effectiveness of green construction. Therefore, how to achieve effective cross-organizational collaboration and optimize green construction management processes remains an urgent issue to be addressed in current research. This paper will, through a case study of a JD hotel project in Hainan, explore the optimization paths for green construction management processes, with the aim of providing theoretical foundations and practical references for the green transformation of the construction industry.

3. Construction of a Green Construction Management Process Model

This study will thoroughly analyze the deficiencies in the collaboration and integration of project planning, design, construction, and operation stages within green construction management [3]. By exploring paths for optimizing the collaborative mechanisms between these stages, the goal is to enhance the overall effectiveness and sustainability of green construction. At the same time, the study further focuses on the integrated application of green construction technologies. Through methods such as integrated design, lean construction, and integrated interior decoration, the industrialization level of the construction process will be systematically improved, reducing resource consumption and minimizing environmental impact [6].

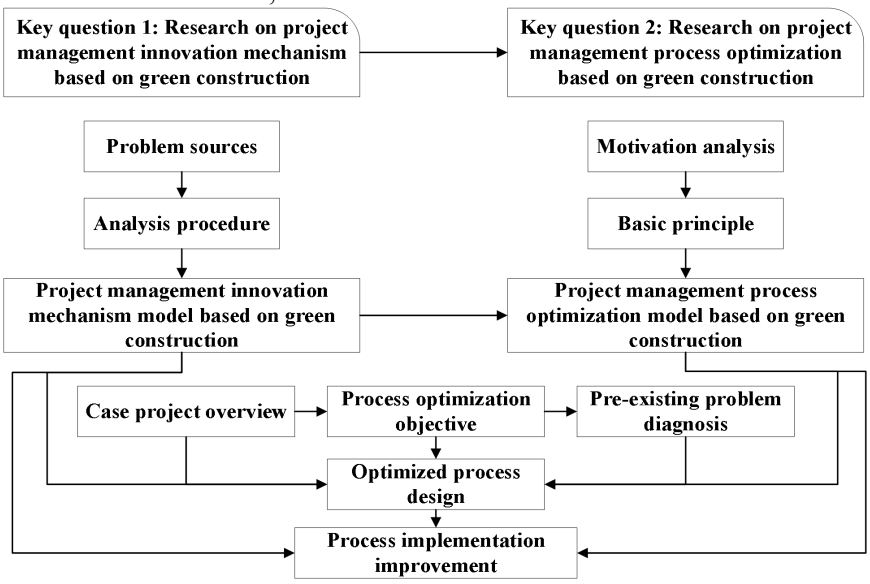


Figure 1. Technical Roadmap

Building on this, the study proposes an innovative green construction management process model aimed at addressing the numerous issues present in current green construction practices, particularly the communication gaps between the design and

construction phases, as well as the lack of effective collaboration in the management process. This model integrates various management mechanisms and technical approaches and has been validated through practical case studies. Through case analysis, the study further explores how this management model can be applied in actual projects to promote the green transformation of the construction industry, providing theoretical foundations and practical support for the sustainable development of green construction. The technical roadmap for this study is shown in Figure 1.

3.1 Construction of a Green Construction Management Process Model

The optimization of the full-process green building project management flow is a supplement and optimization to the management model built for the application of green building throughout its lifecycle [7]. Therefore, when formulating the management process, in addition to maintaining the basic framework of the original project implementation management process, the specific needs of green construction should be incorporated in a personalized manner, integrating the application of green construction technologies to enhance the overall level of greenness in the project. In terms of project organizational structure, the general contractor should shift from the traditional model of a single organization with multiple specialties to a collaborative and coordinated model involving multiple professions and organizations. Regarding project process management, the general contractor should transition from a construction-by-drawing and auxiliary optimization model to a highly efficient collaboration model among upstream and downstream enterprises across the entire process, including design, production, construction, and consulting [8].

In traditional green construction project management processes, the primary responsibility typically lies with the construction unit, while the involvement of the client and design units is relatively low, failing to fully stimulate the enthusiasm of all stakeholders [9]. A specific example of the traditional green construction project management process is shown in Figure 2.

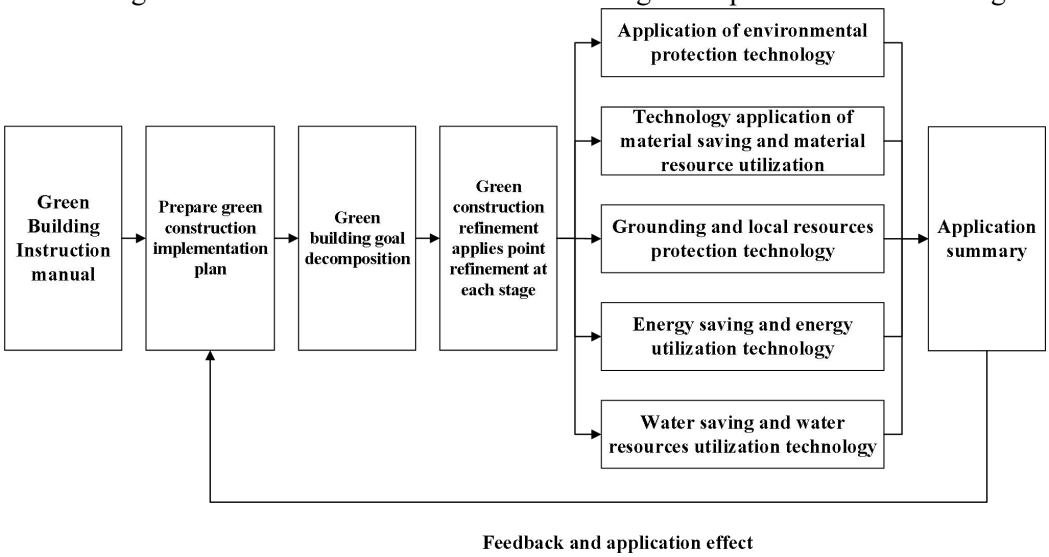


Figure 2. Traditional Management Process for Green Construction Project Application

In innovating the green construction project management process, it is essential to consider the coordination and collaboration of multiple specialties and organizations, driving the shift from traditional management models to cross-disciplinary and cross-organizational cooperation [10]. At the same time, the full-process management of the project should be coordinated from a higher-level perspective to ensure the optimization of the overall green construction planning, thereby achieving the optimal comprehensive benefits. The innovated management process is shown in Figure 3. The introduction of multiple specialties and organizations will facilitate adaptive changes in the green construction management process. Through the supplementation and optimization of the process, the goal is to construct an innovative model for optimizing green management

mechanisms. The specific process includes the following aspects:

(i) The client and design units will jointly participate in the green construction planning and decision-making process, collaborating with the construction unit at the core to ensure the effective integration of the developer's intentions and the professional design scheme, thereby achieving the overall optimization of the project's green construction.

(ii) The consulting unit will be introduced as an independent third party into the implementation of green construction, providing professional guidance and advice on management activities, as well as participating in cost control to ensure the achievement of green project goals and the rational utilization of resources.

(iii) As the main body responsible for implementing green construction, the construction unit is required to provide real-time feedback on the effectiveness of green construction applications during the project implementation, ensuring that the client and design units can stay informed of project progress and make necessary adjustments and optimizations.

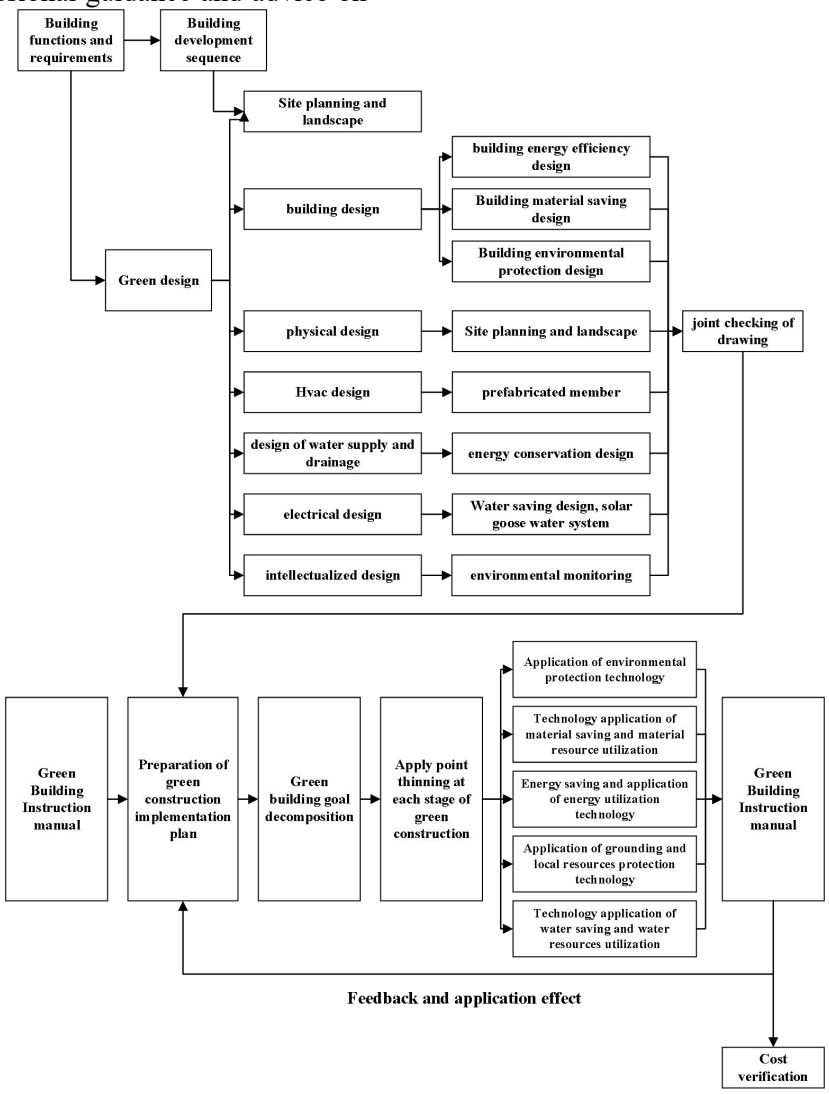


Figure 3. Innovative Management Process for Green Construction Project Application

3.2 Case Application

3.2.1 Project Description

The JD project in Hainan is located in the Xinglong District of Wanning City, Hainan Province, at 18 degrees north latitude. The total construction area of the project is 52,466.1 m², with 36,405.1 m² above ground and 16,061 m² underground, including 1,120 m² of solar energy compensation area. The building height is 21.75 meters, and the total investment is 290 million RMB. The project has been awarded several prestigious honors, including "Top Ten Landscape Design of the

Year" at the Planning and Design Competition, the "7th Aijing Award International Landscape Architecture Award," and the Tianjin Excellent Survey and Design Award. It has also won multiple honors such as the "Green Island Cup" in Hainan Province and the "Luban Award" for construction projects in China. The energy-saving effects during both the construction and operation phases are significant, making it a typical case of green construction empowered by management.

3.2.2 Analysis of Case Application Points

(i) Achieving Effective Integration of Construction Development and Green Construction

Based on the characteristics of this project, the development is divided into three phases, as shown in Figure 4. Due to factors such as land clearance, the construction sequence was adjusted according to actual conditions, resulting in a leapfrog development pattern. The first area to meet the conditions for commencement is the five-star hotel located at the front of the peninsula site. However, the planned municipal road only reaches the central southern part of Plot 32, and the surrounding land is protected forest, which does not allow for the construction of temporary access roads. Currently, there are limitations due to the construction unit's single-line management approach, a lack of effective horizontal collaboration between the design and consulting units, and insufficient coordination and feedback from the construction unit, making it difficult to achieve an optimal solution through comprehensive selection and comparison.

Figure 4. Project Development Sequence

According to the traditional management process, the steps are as follows: land clearance status - construction development sequence - overall site road planning - implementation by the construction unit. Based on this management process, after the commencement of the five-star hotel, the project team promptly understood the construction unit's development sequence and coordinated the design of internal roads for Plot 32. A combined permanent and temporary road solution was adopted to resolve the issue of temporary construction access roads outside the five-star hotel site (approximately 200 meters, 6 meters wide). In accordance with the overall development plan of the construction unit, the design unit's drawing schedule was coordinated and adjusted, with the construction unit playing a key role in providing feedback and coordination between the site layout and overall development work. The construction unit optimized certain work plans, while the consulting unit participated in cost estimation, thus achieving the optimization of economic benefits. The optimized process is shown in Figure 5.

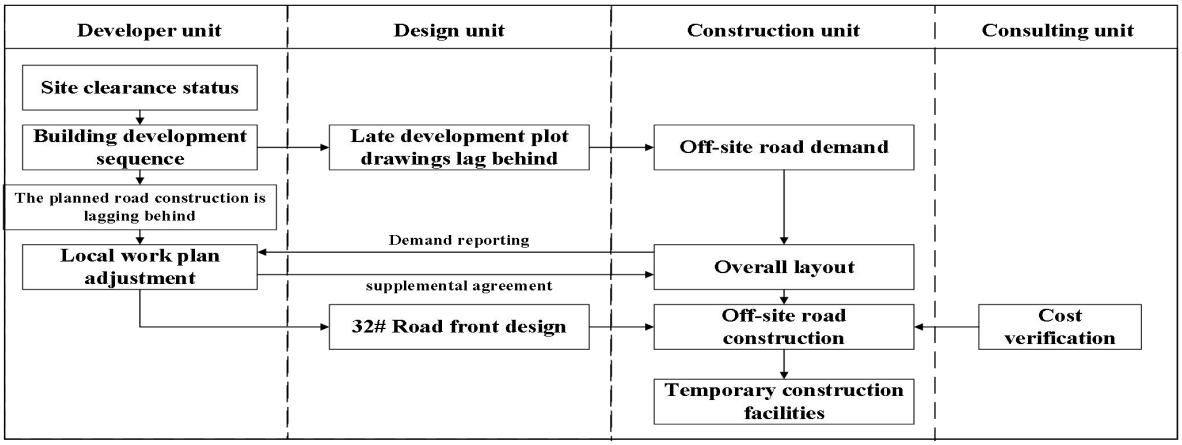


Figure 5. Off-site Road Land Conservation Management Process for the JD Hotel Project in Hainan

The process specifically includes the following steps: (1) Due to land clearance issues, the construction development sequence was altered. The originally planned off-site road was located in a forested area, and the clearance of vegetation was delayed. The land clearance for Plot 32 was not completed, which postponed the development work. After the entry of the general contractor for Phase 1, the construction, design, and third-party consulting units coordinated to jointly plan and design the internal road for Plot 32, successfully shortening the originally planned temporary off-site construction road by about 120 meters. This reduced the occupation of forest land by 960 m², minimized tree felling by 64 trees, and saved 144 m³ of concrete raw materials. (2) A supplementary agreement was signed, increasing the project volume while reducing the scope of phased land clearance, thereby lowering the development costs for the construction unit and achieving a truly mutually beneficial outcome.

(ii) Achieving the Coordination and Integration of Building Functionality and Green Construction

This project utilizes a solar water heating system with a circulating heat collection and supply system, making full use of solar energy. The system employs solar flat plate collectors with an area of 1,120 m², which is a key component of the green design for this project. However, the installation of solar panels required multiple small support piers on the roof, which increased the difficulty of controlling the quality of the waterproofing details, as illustrated in Figure 6.

The traditional management process is as follows: the construction unit determines the building functionality - the design unit conducts energy-saving design - the construction unit implements the design. This process is based on a directive, linear management approach that lacks feedback from the design and construction units and lacks horizontal intervention from the consulting unit, making it difficult to achieve the optimal solution through comprehensive selection and comparison. The optimization of this management process is as follows: based on the construction unit's functional requirements, the design and construction units collaboratively provide comprehensive feedback and optimization on the energy-saving design and construction plans. Meanwhile, the construction unit adjusts the directives, and the consulting unit is responsible for cost estimation, ensuring the optimization of economic benefits. As shown in Figure 7.

Figure 6. Solar Panel Support Piers for the Project

The process specifically includes the following steps: The project is located at the 18th parallel north, where there is abundant sunlight, so the design adopted solar flat plate collectors. However, this also led to the issue of excessive small support piers on the roof, which increased the difficulty of controlling the quality of the waterproofing work. Through communication with the design team, the original design's closely spaced independent small support piers were connected and cast

with plain concrete. The embedded parts were sealed using sealant or waterproof coatings, and after adding two layers of waterproof coatings, the waterproof membrane construction was carried out. Although this process increased the amount of concrete by about 20 m³, it reduced the additional layer of waterproof membrane by approximately 290 m². Moreover, the process is relatively simple and, while ensuring the functionality of the solar roof, it also ensured the quality of the roof's waterproofing work and the building's functional use. To date, no leakage has occurred, achieving a balance between material conservation and environmental protection.

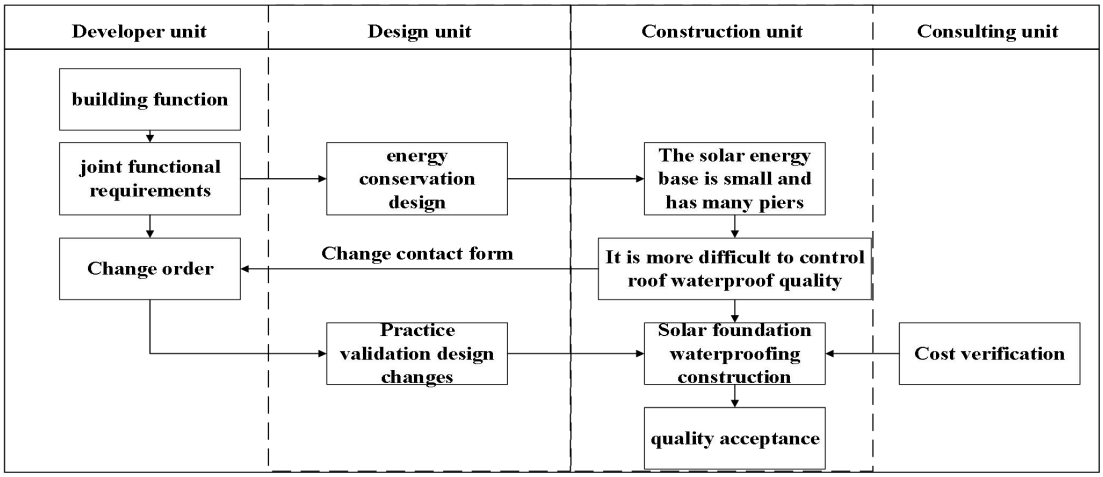
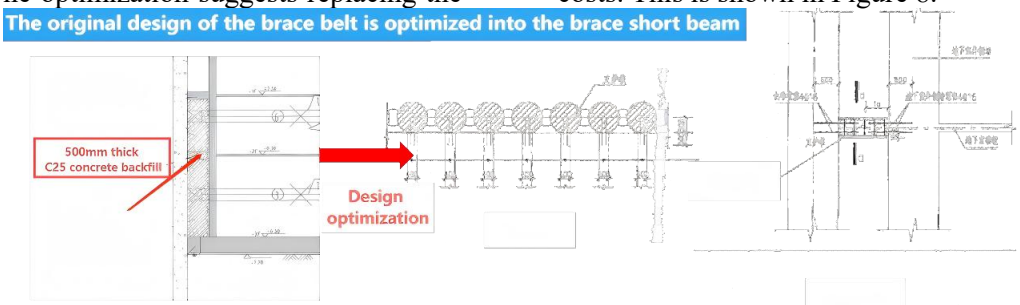


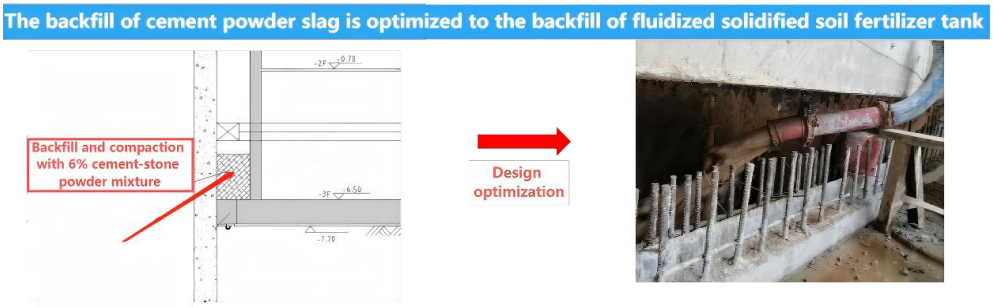
Figure 7. Solar Energy Energy-Saving Construction Management Process for the Project

(iii) Achieving Coordination and Integration of Green Construction Management

Due to the traditional management process being based on a directive, linear approach driven by design intent, it lacks feedback from the design and construction units regarding process and material selection based on green construction, and also lacks horizontal involvement from consulting units, making it difficult to achieve the optimal solution through comprehensive selection and comparison. Based on the characteristics of this project, the optimization is as follows: (1) Under the premise of meeting the architectural and structural functions, the original design plan is subjected to feasibility analysis and optimization. The construction unit, based on specific construction needs, takes the lead in submitting an optimized plan with green and environmental considerations as the primary focus. The optimization suggests replacing the original 500 mm thick C25 concrete slab between the basement floor and support piles with a 400 mm × 400 mm concrete short column between the basement exterior wall and the supporting piles. The short columns can be poured simultaneously with the basement beam and slab. Once the concrete reaches 85% strength, there is no need for backfilling cement stone powder, allowing for formwork removal, thus shortening the construction period while balancing low cost and environmental energy efficiency. (2) The optimization plan involves using fluidized solidified soil for backfilling the foundation pit to achieve the reuse of foundation soil, which is reported to the supervision unit. The construction unit coordinates with the design, supervision, and third-party consulting units to jointly research and successfully shorten the construction period and reduce construction costs. This is shown in Figure 8.



(a) Optimization of Construction Technology for Replacing Concrete Slab Bands



(b) Use of Fluidized Solidified Soil for Backfilling of Foundation Trenches

Figure 8. Process and Material Solution Optimization Design

4. Conclusion

This paper follows the research framework of " logical analysis - problem identification - application needs - model construction - practical application - optimization", using a JD hotel project in Hainan as the research subject. It analyzes the traditional "construction unit-centered" green construction management model and compares it with typical case studies. The research indicates that the green construction management model based on multi-organizational collaboration has significant practical implications for managing green construction in cross-organizational collaboration contexts. Successful green construction implementation should begin at the design and planning stages, emphasizing full-process and full-participation to maximize green benefits. Based on this, the study constructs a multi-organizational collaborative green construction management model, emphasizing the cooperation of multiple parties, including the construction, design, supervision, and third-party consulting units. This model promotes close coordination between various stages, effectively supplementing and optimizing the existing green construction management process. Through the validation of practical case studies, the application of this management model in the green construction control process is explored, yielding significant results.

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