

Research on the Development of Building Energy Saving and Low-Carbon Concept Running through the Construction Process

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Abstract: Under the background of comprehensive promotion of the dual carbon strategy, low-carbon transformation in construction industry has become an inevitable trend. This paper analyzes the current situation of the popularization of low-carbon construction concept, the implementation of the link and the application of technology, and combs the outstanding problems such as the lack of personnel literacy, the imperfect management system and the lagging popularization of green building materials.

Keywords: Building energy saving; Low-carbon concept; Construction whole process; Green construction management

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1. Introduction

Our country's civil engineering construction volume continues to grow, resulting in high energy consumption, waste emissions and carbon emissions in the construction phase of long-term high, causing a certain load on the ecological environment. Under the guidance of green development and dual carbon goals, it is an important direction for the transformation and upgrading of the construction industry to deeply integrate the concept of energy saving and low carbon into the whole process of construction preparation, on-site construction, completion acceptance and late operation and maintenance. At present, many projects still have some practical problems, such as heavy construction progress, light and low carbon energy saving, lax implementation of low carbon construction standards, difficult implementation of supporting technologies, incomplete management system, etc. Under this background, it is of great value to study the penetration path, shortcomings, and improvement strategy of the energy-saving and low-carbon concept in the whole construction process.

2. Current situation of building energy saving and low-carbon construction process

2.1. Overall status of low-carbon construction concept popularization in the industry

The green and low-carbon development atmosphere in the construction industry has gradually formed, and more and

more construction enterprises have begun to recognize the important value of energy-saving and low-carbon construction, and incorporate green construction and low-carbon management and control into the scope of enterprise development planning and project management. Competent departments of industries have continuously issued relevant guidance and specifications for green buildings and low-carbon construction, guided enterprises to change their traditional construction thinking from the policy level, and abandoned the construction mode of high energy consumption and extensive construction.

The low-carbon construction concept still has faults at the grassroots level of the industry. Although the enterprise management has green development awareness, the construction managers and operators have a vague understanding of the connotation and implementation points of low-carbon construction. Routine construction is still the use of traditional work habits, saving water, electricity, materials and dust control, waste recycling and other low-carbon measures are paid insufficient attention. At the same time, the publicity of the low-carbon concept within the industry mostly stays at the level of document transmission, and lacks normalized publicity, practical popularization and other landing measures, which makes it difficult for the energy-saving and low-carbon concept to be truly popular and unable to be transformed into the conscious behavior of the whole construction process.

2.2. Implementation of energy-saving measures at all stages of construction

Building construction can be divided into many stages, such as preparation, main body construction, decoration, site finishing and so on. In the construction preparation stage, some projects began to reduce resource waste by such means as reasonable site planning and modular construction of temporary buildings; in the main construction stage, water-saving appliances and energy-saving machinery were gradually popularized, and the consumption of water and electricity for construction was strictly controlled; in the decoration and decoration stage, environment-friendly decorative materials were given priority to be used, to reduce harmful gas emissions and excessive consumption of resources and basically form a low-carbon control framework for all links.

There are fragmentation and surface problems in the implementation of energy-saving and low-carbon measures at all stages of construction, and there is a lack of integrated overall management and control of the whole process. Most projects only implement simple energy-saving measures in the easy-to-execute link, and continue to follow the traditional extensive construction mode in the earthwork excavation, template turnover, scaffolding erection and other high energy consumption and high emission links. In the construction process, due to the lack of low-carbon convergence planning, resource consumption and construction waste disposal are more common. At the same time, each participating unit has its own way. The construction, construction and supervision units have not formed a synergistic low-carbon management and control force, which leads to the difficulty in implementing energy saving measures in the whole process.

2.3. Popularization of the application of supporting technologies for low-carbon construction

With the continuous development of building science and technology, low-carbon supporting technologies such as assembly construction, green insulation technology, utilization of recycled building materials and intelligent management and control of construction flying dust are becoming increasingly mature. This provides technical support for the development of energy-saving and low-carbon throughout the construction process. Large-scale engineering projects shall actively introduce new energy-saving construction machinery and intelligent energy consumption monitoring equipment, realize real-time management and control of construction energy consumption and precise control of carbon emissions by relying on new technologies, and gradually show the demonstration effect of low-carbon technology application, laying a foundation for industrial technology upgrading.

Low-carbon construction supporting technology overall coverage is limited; there are obvious regional differences and enterprise differences in technology promotion. Economically developed regions and large construction projects are more willing to invest in the introduction of low-carbon new technologies and equipment. Small and medium cities, subject to the restrictions of costs and technical talents, still rely on traditional construction technologies, and the utilization rate of new low-carbon

processes, recycled building materials and intelligent management and control technologies is low^[1].

3. Existing problems of integrating energy-saving and low-carbon concepts into the whole construction process

3.1. Lack of professional knowledge of low carbon and energy saving for construction personnel

At present, the overall cultural level and professional quality of front-line employees in the construction industry are relatively low; most of them only master basic operating skills, lack professional knowledge related to energy conservation and low-carbon emission reduction, and have an unclear understanding of the sources of energy waste and carbon emissions generated in the construction process. The construction management personnel focus on the progress, quality and safety management and control, and do not have a comprehensive grasp of the low-carbon construction norms and energy-saving operation standards, and cannot effectively guide and control low-carbon construction activities on site, so the professional capacity is difficult to adapt to the development needs of green construction.

The industry lacks a systematic professional training system for low-carbon and energy conservation. Pre-job training and on-the-job continuing education focus more on construction technology and safety standards, and seldom set up courses relating to green and low-carbon construction, application of energy-saving materials, carbon emission control, etc. Practitioners lack normal learning channels and cannot timely grasp the new low-carbon construction technology and management methods.

3.2. The low-carbon energy-saving professional literacy of construction personnel is insufficient

The existing construction management system in the construction industry is mainly based on project quality, construction progress and work safety, while the special management system for energy-saving, low-carbon and green construction is not perfect. Most enterprises have not formulated the detailed rules for low-carbon management and control throughout the construction process, and do not have clear provisions on the energy consumption standards, carbon emission indicators and resource conservation requirements for various processes, and there is no basis for on-site low-carbon management, which is prone to loose management and arbitrary implementation.

The implementation of the low-carbon construction management system is weak. Although some enterprises have formulated the green construction management system by referring to the policy documents, it flows in written form and is not really implemented in the daily management of the construction site. Supervisory units lack supervision over low-carbon construction measures, focus only on project quality and safety acceptance, and ignore the implementation of energy-saving measures, carbon emission control and other contents^[2].

3.3. Restricted promotion and application of green and low-carbon construction materials

Low-carbon building materials such as green and energy-saving building materials, recycled aggregates, environmentally friendly thermal insulation materials and workable templates are the basis for realizing energy conservation in the whole construction process. At present, there are more and more varieties of new green building materials, but their popularization and application in practical projects still face multiple obstacles. The production cost of green low-carbon building materials is on the high side, and the market price is higher than that of traditional building materials.

The market standards for green and low-carbon building materials are not uniform enough; some small groups of building materials lack authoritative quality inspection standards and industry certification, product quality is uneven, and there are potential safety hazards in engineering applications. Therefore, construction entities and design entities dare not easily choose new low-carbon building materials due to engineering safety considerations. At the same time, the supply chain system of green building materials is not perfect, the regional supply channel is narrow, the transportation cost is on the high side, and the builders are not familiar with the construction technology of new building materials, which further restricts the popularization and alternative application of green low-carbon building materials in the whole construction

process.

4. Promoting the integration of energy-saving and low-carbon concepts into the whole construction process

4.1. Strengthen low-carbon professional education and training for employees

Build a low-carbon construction education and training system with hierarchical classification, and set up differentiated training contents for enterprise management, field managers and front-line operators. Focus on the training of dual-carbon policies, green construction management system and low-carbon project operation mode for the management; focus on the management personnel's knowledge of energy-saving construction standards, energy consumption management and control methods and low-carbon process planning; focus on the training of practical skills such as energy-saving mechanical operation, use of green building materials and construction waste recycling for front-line workers, and comprehensively improve the overall professional quality.

Enrich the forms and dissemination channels of education and training, abandon the single offline teaching mode, and carry out teaching in combination with online courses, on-site observation, model engineering training, and other multiple ways. Regularly organize industry experts and the technical backbone to go to the construction site to carry out practical guidance, explain the key points of low-carbon construction and common problems. Establish low-carbon literacy archives for practitioners, and link the training and assessment results with post-employment and performance and salary, so as to force practitioners to take the initiative to learn by assessment and form a normalized and long-term education and training mechanism.

4.2. Improve the low-carbon management and control rules and regulations throughout the construction process

Construction enterprises shall, in light of the characteristics of the whole construction process of the projects, formulate detailed low-carbon construction management rules, and specify the energy conservation standards, energy consumption limits and carbon emission management and control requirements for each link of construction preparation, main structure, decoration and decoration, and on-site completion. Improve the special management systems for resource conservation, dust control, sewage discharge, waste recycling, etc, detail the low-carbon management and control requirements to each construction process, and realize that the whole construction process has rules to follow and rules to follow.

Strengthen the implementation of the system and hierarchical supervision, specify the division of responsibilities of the construction, construction and supervision parties in the management of low-carbon construction, and include green and low-carbon construction in the scope of daily inspection, phased acceptance and completion evaluation of projects. A punishment mechanism for violations shall be established to investigate the liability of construction teams and management personnel who waste resources arbitrarily, fail to implement energy conservation measures, or discharge carbides in excess of standards.

4.3. Strengthen the R&D and promotion of green and energy-saving building materials

Encourage scientific research institutions and building materials enterprises to increase investment in the research and development of green and low-carbon building materials, focus on technological breakthroughs in such fields as renewable building materials, energy-saving, environmental protection and thermal insulation materials and recyclable working materials, optimize production techniques and reduce production costs, and narrow the price gap between green building materials and traditional building materials from the source. Improve the green building materials industry standards and quality certification system, standardize the quality of market products, and establish a recommended catalogue of high-quality green building materials to provide authoritative reference for engineering design and material selection^[3].

Expand the market promotion and application channels for green and low-carbon building materials, and the government encourages engineering projects to give priority to the use of green building materials in the catalog through policy subsidies, tax incentives and other means. Build a supply and demand docking platform for building materials,

improve the regional green building materials supply chain layout, and reduce transportation costs. Strengthen the guidance in the design link, give priority to the use of supporting low-carbon building materials in the construction scheme design stage, and meanwhile, carry out the construction process training of building materials to enhance the practical ability of construction personnel to replace traditional building materials with green building materials.

5. Guarantee the path of energy-saving and low-carbon long-term development in the whole construction process

5.1. Improve the low-carbon construction standard system in the construction industry

Based on the national long-term dual carbon development objectives, and in close combination with the current construction development status and future transformation direction of the civil engineering industry, accelerate the improvement of the national unified and local supporting technical standards and management specifications for the low-carbon construction industry, refine and clarify the whole-process energy consumption quota standards, carbon emission accounting methods, resource intensive conservation requirements, construction waste disposal and utilization specifications and other core contents.

We shall promote the in-depth integration and dynamic adaptation of low-carbon construction standards in the industry with the actual operation of the construction site, regularly revise and improve the contents of existing standards and clauses in accordance with the iterative updates of new technologies, new processes and new building materials in the industry, and always maintain the timeliness, scientificity and practical applicability of industrial standards. Establish a unified quantitative evaluation index system for low-carbon construction, set quantitative scoring standards from multiple dimensions such as total resource consumption, carbon emission intensity, effectiveness of energy conservation measures, and comprehensive ecological and environmental protection benefits, directly link the evaluation results with the upgrading of qualifications of construction enterprises, project tendering and bidding finalization, and industrial credit rating, and lead the standardized system construction process in an all-round way to regulate and normalize the development of energy-saving and low-carbon throughout the construction process.

5.2. Promote smart technology and low-carbon construction management

By relying on modern smart construction technologies such as big data, the Internet of Things, wireless sensors and intelligent terminals, build an integrated intelligent management and control platform for energy consumption and carbon emissions at construction sites, carry out 24-hour real-time monitoring, automatic statistical analysis and abnormal dynamic early warning of data on water consumption for construction machinery, electricity consumption at construction sites, energy consumption of large equipment and so on, and promptly rectify and optimize problems such as unreasonable waste of resources and excessive energy consumption.

Accelerate the popularization and application of smart low-carbon construction technologies in the whole industry, comprehensively promote the in-depth integration of BIM technologies in the whole process of project construction, optimize the overall construction scheme through three-dimensional modeling, accurately plan the sequence of cutting size of building materials and the connection of various processes, and minimize material cutting loss and avoid additional energy consumption and carbon emissions caused by repeated construction^[4].

5.3. Establishing a normalized supervision mechanism for low-carbon construction projects

Establish a normalized supervision mechanism for low-carbon construction with the coordination and linkage of various parties among the government departments in charge of housing and urban-rural development, construction industry associations and third-party professional evaluation institutions, and conduct whole-process and whole-coverage tracking supervision over the implementation of low-carbon measures for projects under construction within their respective jurisdictions by combining routine inspection, irregular random inspection and special centralized supervision. Focus on

the verification of core contents such as the use proportion of green and energy-saving building materials, onsite energy consumption quota management and control, recycling and utilization of construction waste as resources, construction dust and carbon emission in compliance with standards, etc., and strictly put an end to such adverse phenomena as low-carbon construction superficial response, formalization and falsification.

Improve upon the dual restraint mechanism for public supervision and industry creditworthiness, take the initiative to announce implementation plans for green and low-carbon construction of construction projects under construction, day-to-day implementation and acceptance inspection results, smooth channels for complaints and reports by online and offline masses, and form a good pattern of industry internal regulation and public supervision. Establish special credit archives for low-carbon construction of construction enterprises, fully incorporate the results of routine supervision and inspection and special supervision into the comprehensive evaluation system for enterprise credit, and give incentives such as preferential policies and bonus points for bidding to enterprises that strictly implement low-carbon construction requirements and achieve outstanding results; impose credit penalty, public punishment and qualification constraints on enterprises that violate regulations and fail to effectively implement standards, and force enterprises to adhere to the energy-saving and low-carbon construction mode for a long period of time under normal rigid supervision, so as to stabilize the foundation for green, low-carbon and long-term development of the construction industry.

6. Conclusion

The concept of energy saving and low carbon runs through the whole process of civil engineering construction and is an inevitable choice for complying with the dual carbon development strategy and promoting the transformation and upgrading of the construction industry and the coordinated development of ecological protection. At present, the industry has a certain foundation in the popularization of low-carbon concepts, the implementation of measures in various links and the application of supporting technologies. There are still practical problems, such as the lack of professional literacy of practitioners, the imperfection of the management system, and the obstruction of the promotion of green building materials. In order to achieve long-term development, we must lay a solid foundation in the aspects of professional education and training, sound and perfect systems, and research, development and promotion of building materials.

Disclosure statement

The author declares no conflict of interest.

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