

# Research on Intelligent Construction Technology Based on Green Concepts

*Kai Wang*\*

School of Architecture and Urban Planning, Yunnan University, 650504, Kunming, China

**Abstract.** Compared with other industries, the construction industry has significant energy consumption characteristics. Therefore, actively promoting the green ecological construction in the construction industry is a crucial aspect to follow the current global low-carbon transformation call. This paper introduces intelligent building technology and its embodiment of green building concept. From the analysis of Building Information Modelling (BIM), intelligent building robot, Internet of Things (IoT) and other key technology fields, the significance of the combining of green and intelligent building is summarized. By conserving energy and reducing emissions, efficient use of resources, pollution reduction and other means. The construction industry is enriched by the birth of the construction industry Internet, construction robots, and other new industrial forms, which not only promotes resource conservation and environmental protection, but also promotes technological innovation and industrial upgrading. Meanwhile, these technologies improve building quality and user experience, create a safe, comfortable and convenient living and working environment, and extend the service life of buildings. Therefore, the active promotion and application of smart building technologies based on green concepts is of great significance for building a better and more sustainable future.

## 1 Introduction

The traditional construction industry faces issues such as low energy consumption efficiency, outdated management methods, severe environmental pollution, lack of energy-saving awareness and technological innovation, and short building lifespans lead to energy waste. The construction industry's direct energy consumption contribution to total societal energy consumption is up to 30% [1]. As people's attention to building energy-saving design concepts continues to increase, the National Development and Reform Commission has clarified in the Medium- and Long-Term Special Plan for Energy Conservation that building energy-saving design should meet a 50% standard [2]. Although China has issued a series of regulations and policies related to building energy efficiency, some still lack specific operational details and standards, leading to difficulties in implementation. However, the introduction of intelligent building technologies such as building information modelling (BIM), Internet of Things (IoT), and big data has made intelligence run through the whole

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\* Corresponding author: [mudae@ldy.edu.rs](mailto:mudae@ldy.edu.rs)

life cycle of buildings, thereby improving efficiency, reducing costs, and providing an effective way for the green transformation of the construction industry.

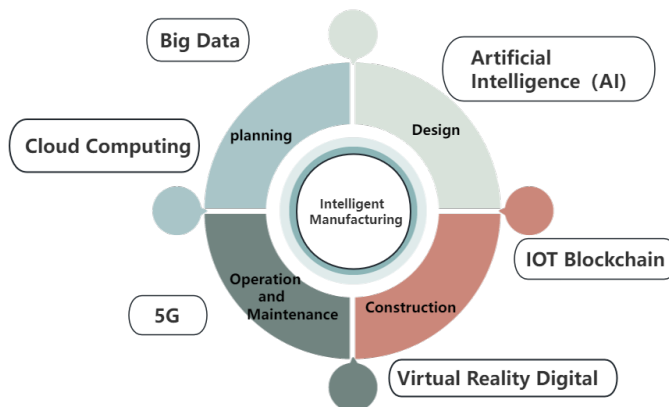
Starting from the growth background and characteristics of green buildings, Liu et al. [3] expounded how intelligent technology can serve the "four sections and one environmental protection" of green buildings, namely, efforts to save energy, land, water, materials and protect the environment. It points out that green buildings and building energy efficiency are two inseparable parts. The construction industry will adopt intelligent construction technology that uses the green concept as a future trend, which will have a positive impact on the harmonious coexistence of buildings and the natural environment. In theory, it constructs a theoretical system of intelligent green buildings to support industry transformation. In practice, it integrates and enhances building performance, such as energy efficiency, indoor environment, and construction efficiency, reduces carbon emissions and energy usage, and promotes the sustainability of the construction industry. Jiang [4] studied the integration instances of intelligent and green buildings. The study mentioned that green intelligent buildings integrate multiple technological concepts, including energy-saving ideas and renewable concepts. From the perspective of contemporary architecture, it is imperative to abandon the traditional energy-intensive development model and transition towards a modern, green, and intelligent development approach, with smart buildings and green buildings being the primary manifestations of this transformation [4].

Based on research on BIM technology, IoT technology, intelligent construction robots, and other technologies in building construction, this paper analyses the intelligent application of green building concept to guide the intelligent construction of civil engineering and foster the green development of buildings.

## **2 Overview of intelligent construction and green buildings**

### **2.1 Summary of intelligent construction technology**

Intelligent buildings are widely regarded as the inevitable path for the construction industry will undergo transformation and upgrading in the future [5]. However, at the current stage, intelligent construction is still in the nascent phase of its product life cycle. The industry's understanding of this field is relatively general, tending to broadly classify all construction processes involving automation and digital technology as intelligent construction, lacking a clear and widely accepted definition to precisely delineate its scope [6]. Figure. 1 shows some specific definitions and elaborations given by scholars on intelligent construction. During the planning phase, big data analysis aids decision-making, and BIM technology lays the foundation for design. During the design phase, BIM, Virtual Reality/Augmented Reality (VR/AR), and Artificial Intelligence (AI) technologies enhance design accuracy and efficiency. During the construction phase, robots, IoT, automation, and unmanned aerial vehicle (UAV) technologies improve construction efficiency and quality. During the operation and maintenance phase, BIM is combined with IoT to achieve intelligent operation and maintenance, sensor and AI technology to optimize building performance and energy consumption management, and comprehensively foster the intelligent upgrading and digital transformation of the construction industry.



**Fig. 1.** Intelligent Construction Technology System [7].

## 2.2 The green building concept reflected in technology

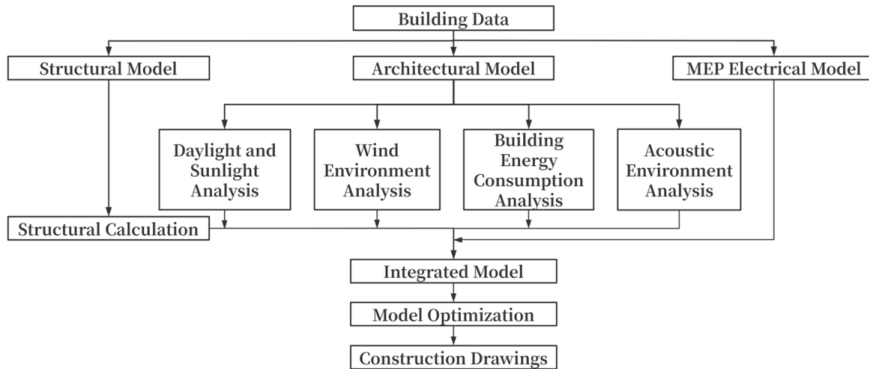
In the process of constructing and developing, green buildings strive to save resources, protect the environment and reduce pollution to the maximum extent through scientific design, reasonable material selection, efficient construction and operation management. This approach aims to promote harmonious coexistence between man and nature and contribute to the building of a sustainable society [8]. The comprehensive integration of intelligent construction technology in various stages of building projects deeply reflects the concept of green buildings. During the planning and design phase, BIM technology is used to optimize building layout and orientation, ensuring that buildings can fully utilize natural light and ventilation. Meanwhile, green building materials and energy-saving designs are adopted to reduce environmental impact. During the construction stage, IoT and automation technologies precisely control the construction process, reducing energy consumption and material waste. Renewable materials and environmentally friendly construction techniques are also adopted to lower carbon emissions. In the operation and maintenance stage, intelligent systems and AI technologies monitor building energy consumption and equipment status in real-time, optimizing energy use efficiency, identifying potential issues in advance, and reducing maintenance costs and environmental impact. The deep integration of intelligent construction and green buildings not only improves the efficiency and quality of building projects but also promotes sustainable development and environmental protection in the construction industry.

## 3 Key technologies and applications

### 3.1 Application of BIM technology

BIM integrates diversified information, including building material types, building structure types, construction progress records, construction cost control, and material durability assessments. This platform ensures the integrity and consistency of information during transmission through interoperability and shareability, meaning the information content remains identical from transmission to reception. This feature significantly reduces project costs, saves time, and enhances overall productivity, aligning with the green building concept [9]. BIM technology optimizes building structures and systems (such as HVAC and plumbing) through precise modelling, improving energy efficiency and space utilization. It also supports

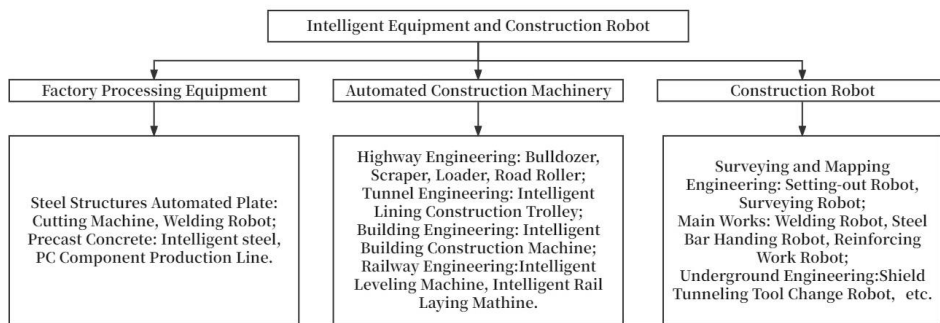
multidimensional design analysis, including sunshine, wind energy, energy consumption, and acoustic environment, promoting green buildings and sustainable development. Figure 2 depicts the flowchart for using BIM technology in architectural design and construction management. It involves establishing building models using software such as Revit, conducting structural calculations with PKPM, performing environmental analysis with software like Ecotect and Phoenics, and ultimately integrating models and optimizing them in Navisworks to generate construction drawings. BIM technology integrates all information related to building projects, providing a platform for multi-party collaboration and driving digital transformation in the construction industry.



**Fig. 2.** Green Building Design Process Based on BIM Technology (Data from: [10])

### 3.2 Applications of intelligent construction robots

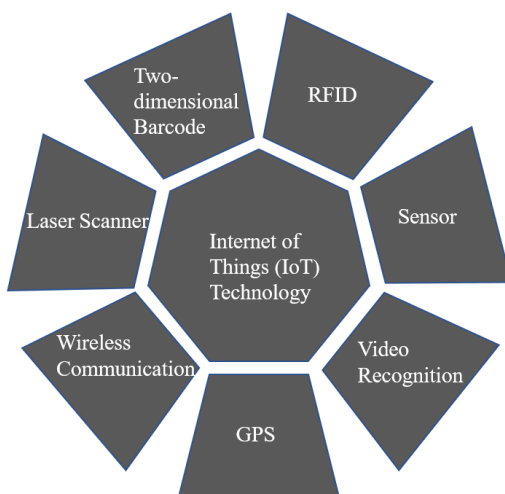
The construction industry is moving towards unmanned and labour-reduced operations, leveraging automation tools and intelligent robots. These devices can operate autonomously by following preset programs or immediate instructions, significantly reducing the burden on human labour and enhancing construction efficiency [11]. The application of intelligent equipment and construction robots during the construction phase is illustrated in Figure 3. Intelligent construction robots are high-tech products in the construction industry, designed to improve construction efficiency and safety. They are mainly categorized into several types: Surveying and Mapping Engineering Robots: such as setting-out and measurement robots, which provide precise construction data. Main Works Engineering Robots: performing arduous tasks like welding, steel bar handling, and reinforcement arrangement. Highway Engineering and Steel Structure Robots: covering bulldozing, scraping, concrete placement, and steel plate processing. Precast Concrete and Decoration Robots: automating the handling of precast components and decoration materials. Construction Engineering and Railway Engineering Robots: suitable for high-rise buildings, floor laying, and railway levelling. Underground Engineering Robots: such as shield tunnelling tool-changing robots, designed for complex underground construction. Through automation and precision, intelligent construction robots have significantly improved efficiency and quality in the construction industry.



**Fig. 3.** Intelligent equipment and construction robots (Data from: [12]).

### 3.3 Applications of IoT technology

IoT technology is defined as the connection of any item to the internet through information-sensing devices including RFID, infrared sensors, GPS, laser scanners, and other equipment, which enables information exchange and communication for intelligent identification, location tracking, monitoring, and management. In Figure 4, IoT technology is juxtaposed with technologies such as two-dimensional barcodes, RFID, and laser scanners, suggesting their close collaboration and mutual support in fields like modern logistics, warehouse management, and automated production. Specifically, IoT technology collects vast amounts of data through various sensors and smart devices, which are then analysed and processed using cloud computing, big data, and other technologies to achieve efficient management and optimization of items, equipment, personnel, and more. These technologies can be applied in multiple domains such as smart homes, smart cities, intelligent transportation, industrial automation, bringing great convenience and benefits to people's lives and work. In summary, IoT technology represents an important direction in modern technological development, connecting various items to the internet and enabling intelligent processing and management of information. As shown in Figure 4, IoT technology stands alongside other technologies, collectively forming a crucial part of the modern technological system.



**Fig. 4.** Schematic Diagram of Key Technologies in the IoT (Data from: [13]).

## **4 The significance of the integration of intelligent construction and green building**

The integration of intelligent construction and green building has significantly enhanced the efficiency of building construction. Intelligent technologies such as automated construction, sensor networks, and simulation modelling not only shorten the construction cycle but also optimize building operations through precise control and management systems. Meanwhile, green buildings reduce energy consumption through energy-saving designs. The combination of these two approaches ensures efficiency and intelligence throughout the entire process of building construction and operation, providing a more comfortable and convenient living environment for residents.

Using environmentally friendly materials, renewable energy and optimized building layout, green buildings greatly reduce the negative impact of buildings on the environment. On the other hand, intelligent building technology realizes accurate regulation of building energy consumption and efficient use of resources through intelligent control systems, further promoting energy conservation and emission reduction. The combination of the two not only protects the ecological environment, but also promotes the sustainable development of the construction industry.

Although the initial investment in intelligent construction and green buildings may be higher, in the long run, they bring significant cost control and return enhancements to investors. Green buildings reduce long-term operating costs by lowering energy consumption and maintenance costs. Intelligent construction technologies further reduce total costs by improving construction and operational efficiency. Moreover, as society's demand for green and intelligent buildings increases, these building projects often have higher market value and competitiveness, bringing higher investment returns to investors. Therefore, the integration of intelligent construction and green building is an inevitable choice for the future development of the construction industry.

## **5 Conclusion**

This paper focuses on the significant trends of intelligent construction and green buildings in the construction industry's future development, proposing a theoretical framework for their integrated development. Firstly, the basic concepts of intelligent construction and green buildings are outlined. Subsequently, this paper comprehensively reviews the widespread applications of BIM technology, intelligent construction robots, and IoT technology in building construction. These technologies not only support the digital transformation and intelligent upgrading of the construction industry but also promote the deep implementation of the green building concept. The integration of intelligent construction and green buildings brings notable advantages in efficiency enhancement, environmental benefits, and cost control. By means such as precise modelling, optimizing building structures and systems, and improving energy efficiency and space utilization, it significantly boosts the design efficiency and quality of green buildings. At the same time, this integration shortens the construction cycle, optimizes building operations, reduces the negative environmental impact of buildings, provides inhabitants with a more comfortable and convenient living environment, and promotes sustainable development in the construction industry. Furthermore, the application of intelligent construction technologies can provide more precise and efficient support for various stages of green building design, construction, and operation, facilitating the in-depth implementation of the green building concept. However, it is necessary to intensify technology research and development efforts, improve technical standards, and address issues such as incomplete technical systems, technical barriers, and inconsistent standards. In the future, with the continuous advancement of technology and the

expansion of application scenarios, the integration of intelligent construction and green buildings will become even closer, providing humanity with more efficient, environmentally friendly, and comfortable living environments.

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