Application of BIM Technology in the Design of Leisure Agricultural Landscape Projects

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Abstract: In recent years, with the gradual emphasis by relevant national departments on residential environments and leisure agricultural landscapes, the field of leisure agricultural landscapes has made great strides and growth. The effectiveness of the construction of leisure agricultural landscape projects can directly impact people's living experiences and promote the self-recovery capacity of urban ecosystems to some extent. To ensure the scientificity and rationality of the construction process, we need to update technologies, introducing BIM technology, which has been validated in architectural design and construction fields, into the design of leisure agricultural landscape projects. Traditional design methods are often limited by the constraints of two-dimensional drawings, making it difficult to fully express the designer's creativity and intentions. However, BIM technology can present the designer's creativity and intentions more intuitively through three-dimensional models, providing more design inspiration and choices for designers.

Keywords: BIM technology; leisure agriculture; landscape engineering;

1 Introduction

The development of leisure agriculture not only improves the economic development of rural areas but also plays an important role in excavating, protecting, and inheriting rural culture. In this process, it promotes the further development and enhancement of rural culture. Through the promotion of leisure agriculture, we can delve deeper into and showcase the unique charm of rural culture, allowing more people to understand and appreciate the rich connotations of rural culture.

2 BIM Technology in the Design of Leisure Agricultural Landscape Parks

The application of BIM technology can promote the innovation of leisure agricultural landscape park design. Traditional design methods are often limited by the constraints of two-dimensional drawings, making it difficult to fully express the designer's creativity and intentions. However, BIM technology can present the designer's creativity and intentions more intuitively through three-dimensional models, providing more design inspiration and choices for designers[1]. At the same time, BIM technology can also perform multi-scheme comparison

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and optimization, helping designers find the best design scheme, enhancing the innovation and competitiveness of the design.

2.1 Design Principles of Leisure Agricultural Landscape Projects

2.1.1 Principle of Taking Advantage of the Situation:

Leisure agricultural landscape projects should follow the local regional characteristics and location factors, guiding the development trend. It is necessary to thoroughly investigate the development status of local tourism, transportation factors, economic development status, tourism resources, etc., to act according to the situation, respecting the local natural landscape, and not destroying the existing conditions to achieve an enhancing effect. This approach not only protects local natural resources but also makes full use of existing resources, reducing construction costs.

2.1.2 Principle of Coordinated Development:

Leisure agricultural landscape projects have the characteristics of a comprehensive industry. In the development process, it is necessary to coordinate and promote the coordinated development, conforming to national strategies and local policies, promoting the coordinated development of natural ecology, rural agriculture, economic development, political strategies, and the tourism industry, forming a stable union. This principle requires leisure agriculture to develop the rural economy, connecting it with urban economic development, achieving common prosperity, satisfying urban residents' needs for leisure and entertainment, while also meeting the rural residents' need to return to their hometowns for employment, driving rural economic development, promoting urban-rural economic integration, improving the phenomenon of rural population outflow, and narrowing the urban-rural gap.

3 Key Factors of BIM Technology

BIM, short for Building Information Modeling, falls under the category of data management. It is based on computer-aided technology, forming multi-dimensional models, emerging as a new tool in architecture, engineering, and civil engineering[2]. It revolves around creating virtual three-dimensional models of architectural engineering, utilizing digital technology to break through the limitations of two-dimensional image technology, providing real-time data information, reducing costs, and improving efficiency.

3.1 Visualization Factors

By using BIM technology, traditional architectural components, previously presented only in line form, can be transformed into realistic three-dimensional graphics, providing observers with an intuitive and concrete visual experience. These three-dimensional models are highly interactive and can provide real-time feedback on various information, making the relationships and changes between components clear at a glance. More critically, since the entire building lifecycle (from design to construction to operation) is conducted in a visual state, all stages of the project—communication, discussion, decision-making—can be based on these intuitive three-dimensional models, significantly enhancing project efficiency and accuracy.

3.2 Three-Dimensional Design Collaboration Factors

In the planning phase of buildings, BIM plays a crucial role, especially in coordinating various professional designs. Through BIM technology, potential collision issues between various disciplines can be anticipated and resolved early in the project, automatically generating coordination data for the team to reference. Beyond collision detection, the coordination functions of BIM extend far beyond. For example, in elevator shaft layout, BIM can ensure that its design meets mechanical and electrical system requirements while also guaranteeing sufficient headroom to meet building codes and usage needs. BIM functions as an intelligent coordinator, anticipating and resolving various design issues early in the project, ensuring the smooth progress of the building project.

4 BIM Technology in the Planning Methods of Leisure Agricultural Engineering Parks

4.1Site Digital Modeling

BIM technology can rebuild digital models of on-site terrain. Buildings, roads, and terrain can be clearly displayed in the model of the site. Additionally, the application of BIM technology in conjunction with GIS technology and real-scene three-dimensional modeling technology can generate high-resolution three-dimensional models with real coordinates and texture maps[3]. Based on these high-resolution models, various data analyses or assistance for other BIM software in site model reorganization can be performed, including but not limited to elevation views, section views, layout plans, detail drawings, and elevation models(Example: Figure 1).

Fig. 1. BIM 3D Display Image
The image is an AI-generated BIM (Building Information Modeling) 3D scene.

4.2 Design Scheme Expression

Constructing roads, highways, houses, agricultural buildings, and rain and sewage pipes in the model through an integrated approach, combining the model with the terrain to ensure the

project plan is presented as a whole. It also assists in later measurement and construction period planning, ensuring the entire model is presented in a complete form throughout, maintaining the completeness and stability of information attributes during the design process(Example: Figure 2).

Fig. 2. Aerial View of the Leisure Agriculture Landscape Park
The image is drawn by the author.

4.3 Collaborative Work

The core function of BIM is collaboration. To complete a perfect project, multi-party cooperation and collaboration are required. During the project initiation, continuous communication and scheme optimization are needed to achieve a mutually satisfactory plan(Example: Figure 3). BIM technology simulates and transmits the actual information of buildings, including geometric, physical, and regulatory information, visualizing and sharing the intentions among all parties, making the design scheme more scientific and reasonable[4].

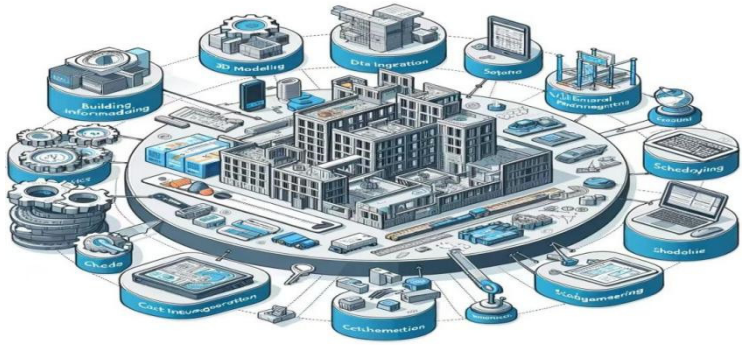

Fig. 3. Multifaceted Information Collaboration Diagram
The image is an AI-generated BIM (Building Information Modeling) 3D scene.

4.4 Budget Control

During the survey and design phase, although project model information is incomplete, the design and planning process is inherently a gradual improvement process. Based on BIM

software, the designed model can calculate the required information through physical models, and then the relevant market price or budget can be calculated either manually or through related BIM cost software, achieving relatively accurate budget control(Example: Figure 4).

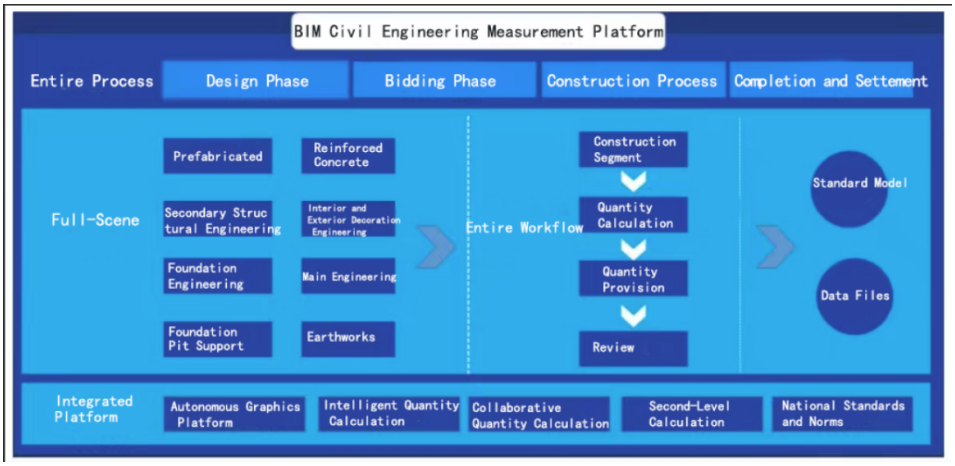

Fig. 4. Civil Engineering Measurement Platform
The image is sourced from Glodon BIM Earthwork Calculation Platform.

4.5 Scheme Evaluation

Based on the site model information designed by

BIM, project information is comprehensive, helping various parties in the project process conduct design judgment and feasibility studies, considering the owner's needs and local laws and policies, using BIM technology for perfection, reaching the final plan(Example: Figure 5).

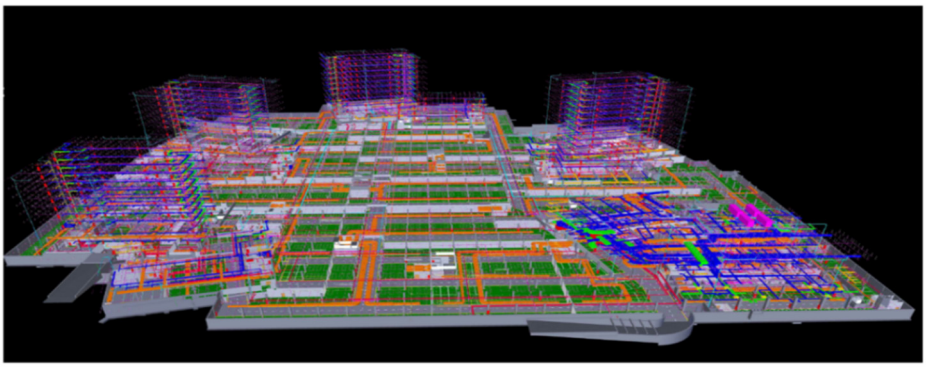

Fig. 5. Plan Evaluation Diagram
Image source: Sichuan Architecture BIM Modeling

4.6 Detailed Design

Due to the particularity of leisure agricultural landscape park projects, multiple factors such as roads, municipal works, buildings, agriculture, landscape, and terrain need to be considered

during project compilation. After coordinating these factors, detailed design of relevant local details is required. For example, for agricultural greenhouses, detailed design of water supply and drainage, lighting, and circuits inside the greenhouse is needed(Example: Figure 6). For building projects, advance calculations and simulations for foundation, deep excavation, and safety construction are required. For roads, terrain adjustments, laying lime soil layers, and checking for fragile corrugated pipes below are necessary[5]. Large projects require planning and judgment of construction processes to ensure construction quality and safety control.

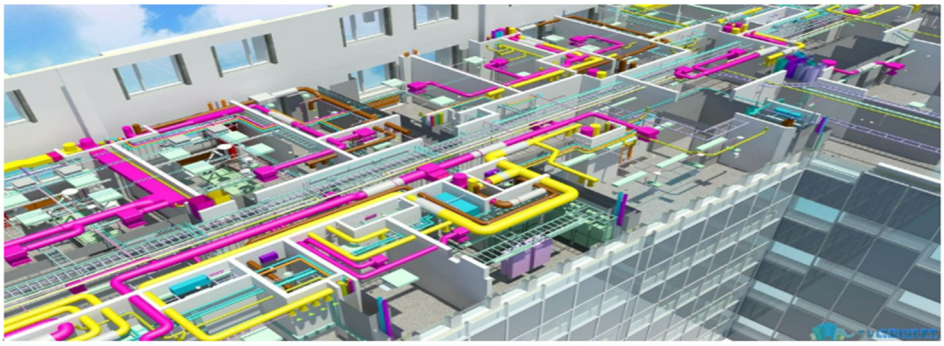

Fig. 6. BIM Detailing Diagram
The image is an AI-generated BIM (Building Information Modeling) 3D scene.

5 Conclusion

This article, based on the summary and utilization of existing research results, further applies BIM technology to the design and construction process of leisure agricultural landscape projects, enhancing design level value and improving the efficiency and quality of leisure agricultural landscape design. Considering its strong professionalism, this research helps the landscape industry better understand the common problems in the design process and how to form a closed-loop connection between construction units, design units, and construction units, providing valuable reference for solutions.

Through this research, we can continuously improve related theories, promote technical iteration and knowledge accumulation, and practice experience upgrades in the entire process of leisure agricultural landscape engineering design, enhancing the competitiveness within the industry. In addition to summarizing and utilizing existing research results, technical innovations and integrations have been carried out. We also look forward to more designers and researchers joining this field, jointly promoting innovation and development of BIM technology in leisure agricultural landscape design.

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