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Innovations in Architectural Design, Materials, and Constructability

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Abstract. Because of the rapid development of social economy and urbanization, people's quality of life has been significantly improved, while people's requirements for housing construction. The requirements of space and environment are also increasing. To effectively meet people's needs, it is necessary to dig deeper into the functions of buildings, increase innovation, promote the integration of architecture and structure, and increase the development growth and to contribute a high level of construction building design. This paper discusses the application of structural design innovation in architectural design, discusses architectural structure design principles, and discusses design innovation countermeasures from the level of integration of architecture and structure in order to promote the further development of the construction industry.

Keywords: Architecture Design, Materials, Constructability, Innovation.

1. Introduction

Architecture, which is based on real life and art and culture, people show various types of architectural structures in the context of real life through their understanding of various types of architectural structures. In architectural design, the designer must not only understand the basic requirements of architectural. In architectural design, the designer must not only understand the basic requirements of the design, but also focus on the optimization of the building structure[1]. In the integration of architecture and structure in the design and optimization of building structures can the total cost of construction can be effectively reduced, and the economic efficiency and longevity of the building can be fundamentally improved. The building structure design can be eztimized.Therefore, when innovating the structural design of the construction building, the designer must choose the type of the construction building structure which should be optimized in a relatively reasonable way, so that the form of the building presents a variety of in this paper[2]. This paper on the innovative study of architectural design for the integration of architecture and structure has practical value. The process of structural design innovation is also a process of integration of structure and architecture. Designers need to fully consider the structural system and actively integrate it with the building shape to effectively reduce construction costs, improve the comprehensive efficiency of the building, and extend its service life[2]. In the process of design innovation, effective measures need to be taken to optimize the structure of the building, so that the building presents a variety of features and has a wealth of functions while ensuring its practicality.

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2. BIM in Architecture design and construction

Building Information Modelling (BIM) is a part of construction's most significant paradigm shifts. Aksamija a. indicates that BIM is able to represent the construction elements as a data-rich 3D object rather than a 2D sketch. Usage of interdisciplinary, holistic, as-built models as a source of derived views rather than a single collection of 'drawings' to infer 3D design[3]. BIM is changing the contemporary practice of architecture. The design approach adopted and how construction documents are prepared, as BIM is the equivalent of a virtual building containing a wealth of relevant information. Because BIM is the equivalent of a virtual structure with rich relation details, it allows for smart, model-based design. The components, systems, schedules, and norms of the construction are stored in the database[3]. BIM is considered to be one of the most promising projects in architecture. Although the BIM tool has existed for quite some time, very few firms, especially small ones, have adopted it. The reason for the reluctance to adopt this technique is that there is little awareness of the long-term benefits that it brings to society. Future work can concentrate on enhancing BIM-based VR to make it more user-friendly[4].The experience of VR could be enhanced, for example, In order to simplify the BQ timetable so that customers can get a full picture of the schedule and the cost, rather than haging to be explained by a building specialist. It is also proposed to focus on increasing awareness abog BIM-use VR and how they can help the building industry. It is crucial, as exploring the possibilities of VR and other cutting-edge technologies will broaden the scope for new processes and opportunities to increase productivity[5].

In this process, the architectural elements, systems, schedules, and specs are held in one database and shared across the stakeholders' community. Traditional building design documents (blueprints, profiles, elevations, and details) are just one view of an integrated model[3]. The use of BIM in construction has many advantages over traditional service approaches, including virtual harmony, planning and supervision, model-based planning and creation, and intensive visualization to reach various stakeholders. Modular and prefabricated construction materials are also possible. The main advantage of BIM is that it enables virtual coordination between stakeholders and trades before construction begins. Virtual coordination between multiple stakeholders and trades and the ability to capture and communicate intentions digitally. The digital representation of design intent and the integration of time and cost is also crucial benefit of using BIM for construction sites, plans, quantities, and materials. During construction process, BIM can be used in a significant way which is determining the installatien of models and improve maintenance. BIM is reducing physical errors and problems on-site. It is an essential tool why doing the construction activities. In addition, model-drivg prefabrication is also beneficial in reducing costs and schedule times. In the construction sector (construction structural, construction mechanical, building electrical, water supply and plumbing, etc.), model-based prefabrication can increase the efficiency of productivity and provide a more controlled environment for manufacturing building components and elements assembled on-site[3].

Hellmuth Obtat Kassabaum (HOK) developed the Anaheim Regional Transportation Intermodal Center in Anaheim, Calif. The building serves as the transportation gateway to Orange County, spanning 34 cities and serving over 3 million people[3]. It includes retail space, restaurants, ticket offices, waiting rooms, and community uses. The facade of the building is made of transparent ETFE that surrounds the Pride Hall. BIM was crucial in the design and construction of the facility, which demanded that complex forms, geometric features, and innovative designs be incorporated into the structure. Apart from Rhino3D ®, Revit ®, and CATIA ® software tools, there are also applications for preconstruction impact detection, energy modeling, performance analysis, and structural analysis. BIM's most significant benefit is the increased collaboration efficiency between design and construction. BIM standards for the design phase are developed through the BIM planning process and specify the delineation of the leading models, the people responsible for modeling and developing specific parts of the design, communication protocols, and methods of information exchange. The models are foundations, bridges, buildings, structures, mechanical, electrical, plumbing (MEP), envelopes, and 3D systems. The BIM can be applied to design revision, fabrication, energy analysis, CFD, structure analysis, cost estimate, collision detection, spatial planning, and construction schedule[4].

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At present, there are many researchers and industry experts committed to building a BIM standard system in line with our national conditions and the actual situation of enterprises. However, due to lack of time and differences in different industries, different enterprises or different project types and different stages, there is no BIM standard system applicable to all large construction projects (including complex construction projects).

The BIM model is of great significance for sub-contractors. Because of the complexity of the project, there is no way to coordinate the positions of the various components of the building without a model. The manufacturing process of structural steel is based on complicated complex curves, and it is essential to manufacture the model. The structure components were made by CNC technology[5]. Structural order and geometric coordination were applied to design control, and the interoperability of all the components related to the complex shell was encoded into a 3D model, which was reduced to the most basic geometry, points, and arcs. This was used to convey exact design dimensions to all stakeholders. BIM has been applied to coordinate 3-D, visualizations, cost estimates, fabrication, collision detection, construction sequencing, site coordination, procurement, and as built documents.

Therefore, it is necessary to carry out further research on the theory, technology and operation specifications related to the application of data integration between different types and stages in large construction projects and complex construction environments.

3. Application of structural design innovation in architectural design

3.1. Conceptualization in structural design innovation

In architectural design, conceptual design is one of the main applications. According to the conceptual design analysis of structural design innovation, the structural system of the building can be clearly and rationally selected, the location of the building can be rationally selected according to the use and needs of the building, the layout of the building can be analyzed from a variety of perspectives and the design can be rationalized, which is the focus of conceptual design in structural design innovation of buildings[6]. In conceptual design optimization and innovation, a relatively rational system is usually required. Regarding the setting of the foundations, it is important to determine the appropriate foundation type in relation to the functional requirements of the building in order to control the incidence of major building failures[7]. At the same time, in the conceptual design of building structures, large overhangs and openings in the building design should be minimized, mainly in order to avoid the construction of buildings with structural forms that are detrimental to seismic resistance. In terms of improving the safety of building structure design, the innovative conceptual design content of building structure design has outstanding effects and is the key to structural design optimization and innovation.

3.2. Components and details in structural design

The application of building structure design is not only reflected in the conceptual design, but also in the design of components and details. The design of components, including the rational selection of building materials, the improvement of the configuration of the building structure and the rational selection of component sizes, are all important components in the design of building structures[8]. In this process, the design of the building structure needs to analyze the reinforcement situation of the components to ensure that the majority of the components in.

In the construction of buildings, the majority of the reinforcement is within the structural reinforcement range. If the designers do not have a flexible and comprehensive understanding of this design work, it will lead to blind problem solving in the design of construction structures. This will not only affect the optimization and innovation of the structural design of the building, but will also, to a certain extent. The construction safety hazards of building construction will be increased to a certain extent. Therefore, the design of building structures should be strengthened. The design of the components should be strengthened. In addition, in terms of detailing, the focus is on the overall design of the building structure. The design of the building structure is the starting point for the analysis of specific details, including the design of the eaves, the footings of the façade, the ring beams and the

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finials. The design of these structures is a detail that is easily overlooked in the design of building structures. In the structural design of buildings in the design of building structures, attention should be paid to the design and optimization of structural details, from the details.

4. The significance of structural design innovation

4.1. Improving the economic efficiency of buildings

In modern society, it is vital to put emphasis on innovation in the design of building structures, mainly because structural design innovation can improve the economic efficiency of buildings. In recent years, the height of the floors has been increasing, which has led to changes in the size of the walls and the column structure, which are positively correlated with the size of the walls and the main structure. The weight of the structure will continue to increase, making the basic load-bearing capacity of the building an important element in the structural design of the building. As the load-bearing capacity of the building rises, the load-bearing capacity of the wall columns rises, and in the design of the building structure, in conjunction with the building needs the number of pipes and the cost of construction also must increase. If the height of the building is reduced, these problems do not exist. Controlling the height of the building and ensuring that each floor of the building is well lit can reduce the distance between buildings and thus this will reduce the distance between buildings and thus control the area of land used[8]. By innovating and optimizing the structural design of the building, the land use can be improved. The improvement of land use through innovation and optimization of building design can play an important role in improving the economic efficiency of buildings.

4.2. Reducing the cost of building construction

Innovations in the construction design of building structures can not only increase the economic efficiency of buildings but also reduce the cost of construction. Both in terms of changing the use of space and in reducing and in reducing congestion in the use of space. The results of innovation and optimization are clear. A building with more floors The building has a higher number of stores, which improves the utilization of land and the utilization of floor space. The economic development and urbanization of the city have led to a significant increase in the use of land[9]. Economic development and accelerated urbanization have a direct impact on people's demand for housing. The number of high-rise buildings is increasing[10]. With this increase in building height, the distance between buildings will also be increased to provide good light on all floors.

4.3. Innovations in architectural structure and graphic design

During the design phase, attention needs to be paid to the overall structure of the building and the graphic design integration, on this basis to ensure the unity of architectural aesthetics and structure[11]. Through the deep integration of architecture and structure, the structural design system can be further optimized to avoid undesirable situations such as cracking and misalignment of walls. For the corner locations with more load bearing, attention needs to be paid to the structural design, using high performance building materials as the main load-bearing materials to meet people's aesthetic needs based on ensuring structural stability, while optimizing and innovating the entire building structural design system[12].

5. Conclusion

The innovation of architectural structure design needs to be fully integrated with the actual situation, recognize the importance of innovative design in the whole design, promote the deep integration of architecture and structure on this basis, strengthen the innovative research of architectural structure design, effectively improve the overall design level of architecture, meet people's needs, create a better environment of architectural space and create a better environment[13]. Meet people's needs, create a better environment for architectural space, and lay a solid foundation for the development of the construction industry. Laying the foundation for the development of the construction industry.

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There are still many problems with this thesis, such as the lack of a case study, so in the subsequent research the focus will tend to be on solving and discussing the actual problems that exist.

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