

## Application and Research on the suitability between form and structure in architectural design

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**Abstract:** As the first visual impression of architecture, architectural form not only undertakes the task of expressing its own connotation and aesthetic value, but also symbolizes the technical level and spirit of the times. The research on design methods and strategies for structural forms that are highly integrated with architectural space and diversified in system is one of the important issues to be solved urgently in contemporary architecture. At present, the frame structure is the basic structural form in the architectural structure design. The use of frame structure can improve the construction efficiency of building engineering and ensure the quality of building. The relationship between building form and structure can be divided into fit relationship and non fit relationship. The fit relationship can be subdivided into three types: the structural system itself as the essence of building, the decoration of structural components and the decoration of structural components, Architects should actively use the relationship between architectural form and structural system to make the structural system a positive factor rather than a negative factor in architectural design. The architectural form under the traditional creative ideas, aesthetic principles and technical means is no longer suitable for today's needs. The society calls for a more brand-new and dynamic architectural form to change our life and lead us to a new era.

### 1. Introduction

As the first visual impression of architecture, architectural form has always been an indispensable part of its system, a symbol of the spirit of the times and social development, and a material means for architecture to express its own connotation and aesthetic value. To a certain extent, the rapid development of the construction industry is at the expense of the environment, and a large number of construction activities have caused huge energy burden and environmental pollution to the society, among which the phenomenon of environmental pollution is particularly prominent, mainly including the destruction of surface vegetation, the discharge of waste water, waste gas and waste residue, the noise generated during construction, and the waste generated during construction, etc., which has become the key problem that restricts China's sustainable development. Throughout the history of architectural development, the role of architectural structural system in formal expression changes with the development of structural technology. Structural technology has always influenced architectural form [1]. In the age of underdeveloped structural technology, architects are inspired to create architectural forms on the basis of mastering structural technology. In a sense, architectural history is the development history of architectural structure technology. The growing social needs cannot be met by frequent reconstruction and construction. We have to rely on the suitability between form and structure to better adapt to predictable and unpredictable changes [2].

Since 1990s, with the continuous improvement of steel products in China, steel-concrete composite structures have been rapidly developed in the construction industry. With the increasing diversification of architectural modeling and architectural function requirements, various problems encountered in structural design of industrial buildings and civil buildings are also increasing day by day. Therefore, as a structural designer, it is necessary to boldly and flexibly solve some difficulties and key points in structural schemes according to various specifications [3]. Frame

structure is a kind of flexible structure, because its bearing capacity and rigidity are not high, and the relatively small section of the component is the fundamental reason for this characteristic. The building frame structure is similar to the vertical cantilever shear beam, and it is prone to a large amount of displacement in the horizontal direction when subjected to strong horizontal working force. When the height of the frame structure increases, the beams and columns will be displaced due to the increase of the weight of the frame, which will affect the plane layout of the building. If the structure is too rigid, the deformation capacity is poor. When the strong destructive force strikes instantaneously, it needs to bear a large force, which is easy to cause local damage and finally all damage; Although too soft structure can well reduce external force, it is easy to cause too large deformation to be used or even overturn. The fitting relationship includes the structural system itself as the essence of architecture, the decoration of structural components and the decoration of structural components. The non coincidence relationship between the two mainly refers to the intentional or unintentional neglect of the structural system [4].

## **2. Development of modern structural forms**

Although structural problems have always been subordinate to engineering problems in architecture, structural forms have the potential to develop spatial diversity in shaping space. The demand and evolution of structural forms exist in the relationship with structure and space. "Innovation" and "enrichment" are the measurement standard and behavior orientation of the sociality of architectural form. This orientation is manifested in the continuous confirmation of the spirit of the times in form, the continuous "challenge" of historical achievements in technology, and the conscious pursuit of replacing the old with the new and providing users with richer sensory experience and visual choice in aesthetics. Since modernism put forward the concept of separation of skin and bone, the mobility of space has been successfully separated from the structural restrictions. This relationship lasted until the 1960s when the society demanded diversification, and then the structural form was re-integrated into the spatial changes. With the interpretation of spatial mobility, transparency, flattening, etc. in the contemporary information society, the structural form also began to serve as the main body to inspire the creation of space [5]. No matter the spatial form or the system of the structure itself, contemporary architecture is putting forward new requirements for the structure, and the structure is no longer an isolated supporting system. In complex architectural systems, the structure has become a special carrier integrating multi-attributes, linking spatial deduction and constructing spatial creation.

Today, the pursuit of alienation, enrichment and innovation breakthrough of architectural form has gone beyond any era in the past, which has been widely recognized in the architectural field all over the world. Diversification of extension and change structure system: under the trend of liberalization of architectural space form and integration of structure and space, space form puts forward diversified requirements for structure system, and the ways of structure building space are becoming more and more abundant. The structure system completes the improvement, optimization and reorganization of the existing system. The traditional plane structure not only improves its lateral resistance, but also reduces the amount of steel used, and develops towards the goal of lighter weight; At the same time, the rigid structure system is also developing to the flexible, hybrid and foldable spatial structure system, giving full play to the material strength with a more reasonable combination, making the structural stress more clear and reasonable, and the system more economical and effective [6]. First of all, new structural forms often benefit from the discovery of new materials, which constitute the material basis of new structural forms. New construction technology can be directly reflected in the structural system, for example, modern industrial production can greatly improve the accuracy of building components, or through the optimization of the size and shape of structural components, the mechanical performance of building components can be improved, and the internal units of the structure can be more coordinated. Structural logic can be understood as the comprehensive expression of rational structural form and perceptual experience.

### 3. Suitability of architecture and form of expression

Any building is supported by a structural system, so the architectural form should truly reflect the structural system, and the structural system makes the architectural form more expressive. That is to say, the relationship between the architectural form and the structural system is an interactive suitability. As the essence of architecture, the structure itself has different forms of expression under different technical conditions. Once unexpected destructive forces suddenly hit, the purpose of cooperative resistance of all components is to keep the most important components from being destroyed or at least destroyed at last. At this time, sacrifice is inevitable. Who will sacrifice? It is wise to let the minor components bear the disaster first, which is one aspect of architectural form and structural suitability. The quality of the building is now the repeated arrangement of huge wooden structure units, forming a strong image [7]. In fact, to deal with and achieve all things in the world, we must make the movement into movement and the static into static in order to balance; Only those who move and those who are still can be lasting; We must know its origin, apply rules and follow it in order to achieve prosperity. Everything starts with conforming to nature and ends with achieving balance. Many rules are only means, only balance and only unimpeded. This is the importance of suitability. Under the conditions of modern structural technology, the structural system itself, as the essence of architecture, also includes long-span buildings and light buildings. The former includes the small gymnasium in Rome, the Millennium roof in London, etc., and the latter includes light tent buildings for some temporary exhibitions [8] Although the proportion of the structural system itself as the essence of architecture is small, this architectural form is different. It is easy to become the focus of people's attention and the symbol of a city or region.

The structural system has a decisive influence on the architectural form, and determines the architectural style of that period. The architectural form reflected by the structural system rarely takes more measures on the structural components, but only makes some adjustments to them. That is, the use of decoration reflects the architectural form. This is a long-standing relationship between the structural system and the architectural form. In the design process, the force transmission system of the structure should be made clear, so that it can meet the stress requirements of the foundation and meet the relevant standards, and the distance between columns should be kept consistent and arranged neatly [9]. The frame structure should bear the corresponding compressive force in both horizontal and vertical directions, so it is necessary to adjust the position of columns according to the actual situation of the building to meet the stress requirements. In architectural design, construction management is very important. The final construction of the project is determined by these three factors: time, cost and quality (see Figure 1). Time refers to the total construction period of the building from flat to completion. Cost refers to the total amount of money required to complete the project construction, which is mainly composed of material cost, labor cost, machinery cost and other costs. The connotation of quality is relatively rich, including the safety of building structure and the comfort of indoor environment. In many architectural arts that use bare structures to express the idea of technological innovation, the adopted forms and visual means themselves are not technical examples suitable for functional needs. The main purpose of these structural parts is decorative function [10].

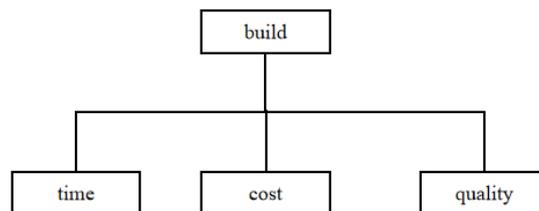


Figure 1 Three factors affecting construction management

### 4. Conclusions

At the design discussion method level, through the design of the supporting structure and

enclosure structure in the building constituent elements, the stability of the house structure, the artistry of the structural nodes and the indoor comfort of the building are realized, and the performance and quality of the house are comprehensively improved. Structural form finding design is first of all a material language conversion mechanism pointing to architectural expressiveness. Therefore, structural form finding design must be viewed in a systematic way rather than in an isolated way, so as to inspire architectural innovation; Different from the traditional standardized paradigm thinking, structural form finding is a bottom-up and multi-dimensional design method, which can explore the uncertainty potential of architecture; At the same time, structural form finding is a performance-based form innovation method, which can make up for the missing technical core in traditional formal methods and has the potential to develop sustainable buildings. Through the suitability between form and structure, the structural parts of architectural design form a stable structural frame through concise connection, and then cooperate with the light and appropriate enclosure structure to create a functional space that is stable, comfortable and can meet people's various needs.

## References

- [1] Yan Jin. Exploration of information-based teaching design for the course of building structure and map reading-take the teaching unit of "Form and scale of stairs" as an example [J]. *House and Real Estate*, 2019, No.557(34):252-252.
- [2] Yang Qi, Lin Ling, Dong Hao, et al. Discussion on the design of low-level radioactive sewage treatment in medical buildings [J]. *Water supply and drainage*, 2019, 45(8):6.
- [3] Yu Bingqing, Yang Yuzhou, Hong Lv Medical. Discussion on the suitability of ground improvement technology for traditional houses in central Henan-taking Fang ding cun Fang Zhaotu's former residence as an example [J]. *Urban Architecture*, 2019, 16(6):4.
- [4] Feng Ya, Nan Yanli, Zhong Huizhi. Thermal and energy-saving design of non-transparent building envelope in South China [J]. *Civil Architecture and Environmental Engineering*, 2017, 39(4):7.
- [5] Zeng Yijun. A Preliminary Study on the Suitability Change of Architectural Space Form and Architectural Function [J]. *Popular Literature and Art: Academic Edition*, 2018(7):2.
- [6] Zhuo Yue, Zhang Bo Study on suitability evaluation of engineering construction geological conditions in Yinchuan City [J] *Construction engineering technology and design*, 2017, 000 (032): 1330-13311328
- [7] Ching yen Chang, Chung Li Hsu, Shu Tzu Chen, et al. Suitability analysis of mountain disaster prevention methods in Duli coastal watershed in Taitung [J] *Nephron Clinical Practice*, 2018, 17(1):20-77.
- [8] Ricardo Delgado Tellez, Wang Shaohua, Zhong Ershun, et al Research on GIS competitive learning method based on sustainable land use suitability analysis [J] *Journal of Resources and Ecology*, 2016(06):26-34.
- [9] Zhao eryang Effective application of form and function in architectural design [J] *Building materials decoration*, 2018, 000 (005): 172
- [10] Cui Linhao On the application of form and function in architectural design [J] *2021(2017-10):295-295*.