Analysis of the design of military building skin under the guidance of camouflage concept

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Abstract: It is very important to apply the camouflage concept to military building design. With the increasing attention of the building skin, there are more and more researches on the use of the building camouflage skin to achieve the purpose of militarization. Based on this, this paper summarizes and studies the ideas, means and methods of building skin design, with a certain reference value for the use of the military building skins in China.

1. Introduction

Military architecture design has its own characteristics, and it requires strong camouflage in many occasions. With the development of stereoscopic detection technology, the demand for military building design is also increasing. In recent years, the research and application of architectural camouflage design has become increasingly important. The camouflage design can effectively reduce the transparency of the air and reduce the probability of identifying important buildings in our army. Traditionally, the main function of the building has been to provide shelter from invasiveness, and it is now gradually shifting to satisfying residential comfort and higher spiritual needs. The most important feature of the building is the epidermis, and the military building skin is an important carrier of architectural connotation. The building skin reveals a comprehensive vision of the building's visual styling and is the interface between the building and the external environment. Therefore, military architecture camouflage research generally focuses on the research and design of building skins. In the design of the military building skin design, the design of the building skin should first meet the interface function requirements, and then pay attention to the interface form expression, in order to achieve the purpose of "fake the real thing" from the visual path.

2. Architectural skin design overview

2.1. Concept

The concept of camouflage was first proposed by Western scholars. Architectural camouflage is an inevitable outcome of the development of architecture to today's society. The building skin is the necessary space for the building. Once the building has no skin, the building no longer exists. The building skin is a partition of different spaces. In Western countries, architectural camouflage is often done by the shape of the building's skin, and the building's skin is attached to the space. The combination of the camouflage concept and the architectural skin design provides new ideas for the symbiosis of architecture and the environment, while guiding the camouflage design of military buildings. For buildings, including building facades, roofs, interior façades, and even building and
other building components, they are connected to different spaces including indoor and outdoor spaces.

2.2. Research progress

The concept of architectural camouflage refers to the way of visually transforming the building's skin shape to make the building blend in the surrounding environment or adapt to changes in environmental factors. At present, the research on the construction of building skin camouflage is still in the exploration stage, and has not yet formed a systematic design theory. Domestic research on the concept of “architectural camouflage” is still blank, but there are some related studies that can be used for reference. In general, domestic research on the concept of architectural camouflage has not yet reached the theoretical stage, but only the study of the building skin.

![Figure 1. Research on the construction of the camouflage skin of the building](image)

2.2.1. Research on the concept of architectural camouflage design. Xuewei Yu expounded the significance of architectural camouflage, the status quo of urban camouflage and existing problems. In the urban camouflage part, the relationship between streetscape building skin and urban texture was analyzed. Zhiyi Chen summarized the design concept of architectural skin in different historical periods, summarized the development history of architectural skin design, and analyzed the influence of post-industrial revolution on the design concept of building skin. Lu Feng analyzed and compared the architectural skin design concepts of modernism and Western traditional architecture since the 20th century.

2.2.2. Research on camouflage of military buildings. Research on the use of camouflage design concepts for military buildings is rare. The design of the military building skin is mainly to explore the design rules of the building skin based on the camouflage concept, summarize the design features and types, refine the design method, and apply flexibly in military building design.

2.2.3. Theoretical analysis of macro perspectives. By analyzing the ideas of architectural skins in various historical periods, Zhiyi Chen reveals the evolution of the position of architectural skins in the theory of binary opposition. Lu Feng explores the important transformation of the epidermis between modernism and contemporary Western architecture in the early 20th century, and uses it as the main structure of the article, in accordance with three independent and interrelated related historical conditions.

2.2.4. Analysis of the relevant works of the example. Through an in-depth analysis of Herzog and Demulon's works, Qun Wang explored the importance of skin design in architectural works. Diyu Liu
explored the different perspectives of different architects on the epidermis through an in-depth analysis of the works of star architects. Starting from the building skin, Yang Lan analyzed and compared the architects and works of Herzog and Demuron and Zumto.

3. Characteristics and types of building skin based on camouflage concept

3.1. Features
The design of the building skin camouflage is to change the shape of the building skin and to blur its existence or volume in the environment. Its characteristics mainly include the potential relevance of vision and thinking, the separability of interface and entity, and the symbiosis of architectural personality and environment.

The first is the potential relevance of vision and thinking. The subjective initiative of human observation behavior is mainly manifested in the "re-creation" of thinking in the process of observation and the replacement of objective things by association and imagination of familiar things. Through the design of the building skin, the observer can be guided to associate the “what” is seen with the “what is known”, and then form the “feeling” to realize the camouflage of the building skin.

Second is the separability of the interface and the entity. This is the basis for the smooth correlation between the potential relevance of vision and thinking. Scientific development and technological advancement make it possible for building skins and building entities to exist relatively independently. According to the requirements of environment and function, the use of advanced construction techniques and materials, through the rich expression of the building skin to form a strong visual impact on people, can weaken the impression of building entities.

Finally, there is a non-contradictory relationship between individual architecture and environmental symbiosis. "Seeking common ground while reserving differences" is the core of the architectural skin camouflage design. The pursuit of individuality in the design of the building skin is a realistic requirement for the design of the building skin in the new era. The design of the building skin can realize the harmonious unity of the personality of the building and the commonality of the site environment. Through the camouflage design of the building skin, the building can be harmonious with the environment on the visual level, reflecting the non-contradictory nature of the individuality of the building and the common requirements of the environment.

3.2. Type
The design of the building skin mainly affects the visual expression through four aspects: material, color, pattern and shape. Combined with the characteristics of the building skin camouflage design, it can be divided into the following four types.

| Serial number | Types                | Application                                           |
|---------------|----------------------|------------------------------------------------------|
| 1             | Locally selected     | Eslite building, urban green space, public building  |
| 2             | Pixel extraction     | Shopping mall logo, commercial advertising           |
| 3             | Silhouette abstract  | Glass curtain wall, outdoor billboard                |
| 4             | Geomorphic simulation| University campus, city park                         |

The first is the type is taken locally. This type of building skin camouflage is the most primitive, convenient and effective. It is mainly used in leisure and small-class buildings located in a good natural landscape. For example, urban green space or public buildings around mountains and waters can be cultivated in harmony with the surrounding environment by cultivating "ecological green walls". In urban blocks that lack natural landscapes, the use of such building skins for building groups and the camouflage of forest effects is extremely interesting.
The second is the pixel extraction type. The design of this type of building skin camouflage is the same as that of the camouflage training suit. It extracts part of the color existing in the environment and combines it with pixels. It can form a pseudo-object effect in a small range and further enhance the camouflage effect. Such as the mall logo and the existing billboards on the ground floor, the building is disguised as a huge commercial.

The third is the silhouette abstraction. This type of building skin camouflage design is mainly based on the visual representation of the graphic silhouette, abstractly imitating other scenes in the base environment, and then applying to the design type of the building skin camouflage design. The concise outline of the silhouette creates a depth of field effect, and the two layers of skin exhibit different light and shadow effects as the sun changes, helping the building entity to blur the “background”.

The fourth is the landform simulation type. This type of skin camouflage design is a comprehensive design of the interface shape, showing a design similar to the landscape features. This type of design is often used in complex urban environments to connect the urban environment in form and function by blurring the boundaries between buildings and sites. For example, the campus of Ewha Women's University in Seoul, South Korea adopts a fuzzy treatment method of “wall” and “top”, and becomes a public green space of campus and city through the combination of building skin and campus landscape square.

4. Design methods and means
In military buildings, the ingenious integration of camouflage concepts can not only achieve the purpose of concealment and security, but also be a concrete manifestation of the development of military technology in China. However, adopting different design methods has different meanings for military buildings with different needs.

4.1. Camouflage design techniques
When disguising the military building skin, you can start with a single layer of skin, by arranging the materials, colors, and patterns, and then superimposing or changing the shape of the skin. Under normal circumstances, the architectural skin camouflage design method can be divided into a single-layer building skin camouflage design and a multi-layer building skin camouflage design.

Regarding the single-layer building skin camouflage design method, the consideration factor is relatively simple, mainly using the material characteristics to eliminate the sense of presence, using the color and pattern simulation environment. The use of materials to achieve building skin camouflage mainly has two forms of active and passive. An example of active use of materials for the design of building skin camouflage is to use a variety of native vegetation to match, through the vertical greening of the building skin to achieve camouflage effect. Passive building skin camouflage design is suitable for special environments such as railway stations, used car recycling plants, etc., in order to achieve the design method of achieving camouflage effect in an environment that is constantly changing. Similar to the principle of using color and pattern for architectural skin camouflage design, the superimposed design method uses the color with gradient or fading effect to abstractly depict the logo pattern in the base, achieving a three-dimensional vivid camouflage effect.

The multi-layer building skin camouflage design method is based on the independent design of a single interface level. Through the arrangement and combination of layers, the flexible and spatial shape of the building skin is given, and the environmental texture or space composition is vividly simulated to achieve the camouflage effect. form. This type of technique mainly consists of superimposing the fuzzy building function of the multi-storey building skin and combining the multi-layer building skin to blank the building volume. For example, the multi-layer building skin with different materials, colors and patterns can be misaligned and superimposed or layered, twisted, twisted, etc., and the visual impact can be achieved through the transformation of the shape to achieve the camouflage effect, and the actual volume of the compact and strict body can be disguised.
Table 2. Means and methods for building skin camouflage design

| Types                          | Specific forms                                      |
|--------------------------------|----------------------------------------------------|
| Design method                  |                                                    |
| Single-layer building skin     | Use material properties to eliminate the presence   |
| camouflage design             | Use color and pattern to simulate the environment  |
| Multi-storey building skin     | Masked skin                                        |
| camouflage design             | Variable epidermis package                         |
| Design means                   |                                                    |
| Fuzzy bottom relationship      |                                                    |
| Fusion with the surrounding   |                                                    |
| environment                    |                                                    |
| Mimic state                    |                                                    |

4.2. Design means
In the field of military construction, architectural camouflage is divided into fuzzy bottom relationship, integration with the surrounding environment, mimicry and other forms. The application of the fuzzy graph bottom relationship is mainly through the continuous reversal of the structure, the connection with the surrounding environment in form and function, blurring the original clear boundary, so as to achieve the purpose of successfully disguising itself in the city. Applications that are integrated with the surrounding environment generally borrow the camouflage method of the protective color of the creatures in nature, and disguise themselves through the changes of the epidermis to achieve harmony with the surrounding environment. The mimetic is to simulate natural forms or natural phenomena from the external form of the building. The most common one is to use the mimetic similar to the environment to hide itself, to form the purpose of harmony and unity. Military construction camouflage skins are designed in a variety of ways, usually with masked skins, variable skins and wraps.

5. Conclusion
With the development of technology, the design based on camouflage building skin is more abundant, and related research is gradually enriched. But overall, the research is still not perfect. However, contemporary skin research has led to the architect's emphasis on building skins, the use of new design techniques, new technologies, and new materials to give the building's skin an unprecedented level of richness and expressiveness. Especially in the specific military engineering buildings, the design of the skin has a very broad space. How to combine the skin design with the technology to achieve the purpose of camouflage in a more environmentally friendly and energy-saving form is a very interesting research topic. Therefore, in the related research in the future, it is possible to conduct research on military buildings as a target, and at the same time pay attention to the absorption of some architectural concepts in the West, and integrate the architectural styles and design methods of our country. Through systematic research, it will have guiding significance for the camouflage design of military buildings in China.

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