Research on Industrial Building Facade Design in Urban Core Area

--Taking 500 kV substation in Beijing CBD area as an example

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Abstract. In traditional design, the image of industrial buildings in the city is often difficult to integrate with the urban environment, resulting in poor integrity of urban design and other problems. Along with People's attention to the urban environment, the industrial building modeling design also needs to be concerned.Based on this, this paper explores the modeling design of industrial buildings in cities, and puts forward four strategies: background,visualization, regionalization and artistic treatment.And take the project in the actual work as the case, explains how to combine with the craft, realizes the harmonious symbiosis with the urban environment.

Keywords: Industrial building, CBD,Substation,Visualization, Regionalization

1 Introduction

With the development of modern design concept, many industrial buildings break through the traditional form gradually, pay more attention to the combination with urban environment, but the theory of this study is less.At the same time, the study of industrial architecture modeling is usually the exploration of architectural reconstruction projects, but for the function of the industrial properties of the building, the number of studies is very small.This paper discusses how to realize the harmonious coexistence between industrial architecture and urban environment by exterior design from the angle of industrial architecture, hoping to make up the scarcity in this field.

Through this study, I hope to provide some strategies and design methods for the design of industrial buildings in the city,enhance the image of industrial buildings in the city, and then enhance the overall environment of the city.At the same time, I hope this paper can be used as a basis for the design of this type of building to provide space for discussion, in the follow-up research can appear more and more rich exploration.

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2 Current situation and problems of industrial architecture in urban core area

In the design of a city and its architectural environment, we pay the most attention to the design of civil buildings, but pay less attention to other buildings in the city. In the contemporary urban design, although the behavior of a large number of newly-built industrial areas is less, but the existence of industrial buildings in the city is essential, and there are some problems in the industrial buildings in the urban areas at present:

The function layout limits the facade modeling design. Traditional industrial buildings often only focus on the function and neglect the character of the building itself, relying on the space, streamline, window opening and other requirements of the process of design, design in accordance with the norms, regulations and design, reflects the cold image of industrial architecture. [1]

Exist in a negative state in the city. The reason of this kind of present situation, on the one hand, is that the property of industrial architecture often gives the impression of cold and distance, and often defaults to the negative space in the city; On the other hand, our neglect of industrial architecture design is also one of the reasons for this phenomenon.

The incongruity between the architectural form and the urban style and features destroys the integrity of urban design. The construction of substation occupies a large space, bare mechanical equipment, the building retains a strong industrial color, and the urban environment is difficult to integrate, building shape flat single. [2]

It is difficult to combine with the urban context. The design of industrial architecture often pays great attention to the function, but neglects the relationship with the city context. On the basis of technological requirements, we need to conduct more in-depth research on industrial architecture modeling, excavate urban texture, carry out functional interaction-such as popular science education and other functions, and enhance the relationship between the city. [3]

Although there are some problems in industrial buildings in cities, the value of industrial buildings can not be ignored. We should excavate the value and the characteristic of the industrial architecture in the design, rather than treat the industrial architecture and the urban environment oppositely. Reduce the negative image of industrial buildings in the city, explore the rational positioning of industrial buildings in the city, give play to the value of industrial buildings.

3 Basic condition of the project

Based on the project in the work practice, this paper analyzes the strategy of industrial architecture modeling design in the urban core area.

The project is located in Chaoyang District, the core area of the CBD(Fig1).The west side of the project is CCTV and the southwest side is CITIC Tower,There are many skyscrapers within a distance of 1 km.The traffic around the site is convenient and the business atmosphere is strong(Fig2).

Fig. 1. Location of project

Fig. 2. Surrounding environment of the project

The building function of the project for the substation is 500 kilovolt, 220 kilovolt integrated mode of construction of the substation,which is very rare in cities.It can improve the reliability of regional power supply, provide guarantee for CBD long-term power supply.It also plays a key role in improving the power supply capacity and reliability in the eastern part of Beijing.

At the beginning of the design, according to the special location and complex functions of the project, mining the main contradictions of the project.For this project, we have found the key to the problem--"Solving the contradiction of building an industrial building in the CBD area of Beijing where there are many high-rise buildings for civil use".

4 Design strategies and project practices

Based on the analysis of the city,location of the project, four main strategies are put forward in the design process:

4.1 Design the building as the background.

The integration principle of urban design is the way to deal with the diversity and contradiction of urban architecture and function, and is the foundation of the integrity of urban design. Substations functionally serve the surrounding buildings.From the urban design point of view, it is more meaningful to take the substation as the background.

Fig. 3. Project renderings

In the design of this project, we use simple architectural form, appropriate architectural color, control the overall image of the building.We do not rob the characteristics of the surrounding buildings,to achieve the integrity of urban design features.(Fig3)

4.2 Visualization of municipal buildings.

Through the visualization of municipal buildings, buildings will be integrated into the urban environment, shape the vitality of the city with other urban elements.

On one hand,this project weakened the industrial sense of the substation in the CBD area.On the other hand, took the surrounding users into account. From the architectural concept extraction to the design of the fifth facade, the building reflected the visual approach.We take “Horizontal skyscraper” as the design theme, the specific implementation of the building shape mainly has the following process(Fig4):Concept Generation, Shape modification, Virtual and real treatment, Material selection.

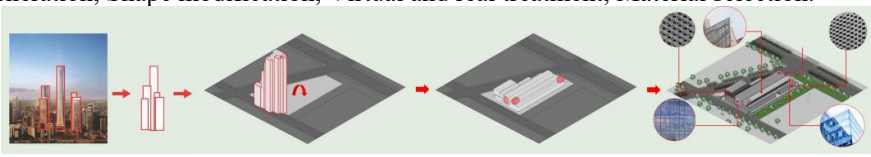

Fig. 4. The process of building generation

The industrialization of this project determines that the process is the main position in the architectural design.This is also the foundation of modeling design.

The original functional scheme has heat dissipation devices on the north, east, south and 13.4 m elevation of the first floor of the building.In the design of the functional scheme, the above-mentioned devices are all placed outdoors.Considering the influence of the equipment on the aesthetics, the reasonable building materials and texture are used to screen the equipment to achieve a more beautiful effect and form a new shape relationship(Fig5).

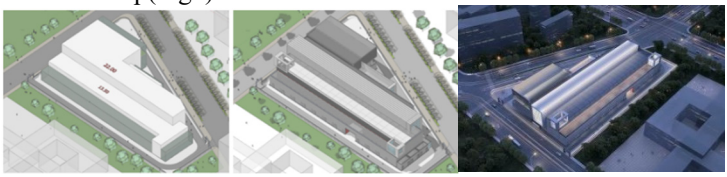

Fig. 5. Comparison of the original volume with the modified mass

4.3 Regionalization of industrial buildings

Through the industrial architecture localization design strategy, the conventional substation building“All the same”, “Square box”, “No place spirit” and other inherent impression were weaken. Industrial buildings should reject the sense of alienation from the urban environment, which makes it possible to solve the contradiction of symbiosis between industrial buildings and human settlements.

Fig. 6. Typical colors of city and the building

For the localization of the treatment, through the selection of materials to simulate the texture of traditional residential buildings in Beijing.At the same time, the traditional color of Beijing city is chosen as the main color of the building-red and gray,which is also the requirement of Beijing urban design guidelines for urban color(Fig6).

For the facade brick-like texture of the practice, in the double skin on the basis of the details of a detailed deliberation.In the design of this project, when the node of the building is designed, the effect is strictly controlled, and various schemes were compared .Take hollow-out walls as an example, at the beginning of the design, because of the cost and other factors, we choose aerated concrete as the material.At the same time, there are many problems:On the one hand, the façade is decomposed by many horizontal lines;On the other hand, the light placed in the wall cavity will be interrupted by the horizontal floor slab, which will affect the night scene lighting effect(Fig7).

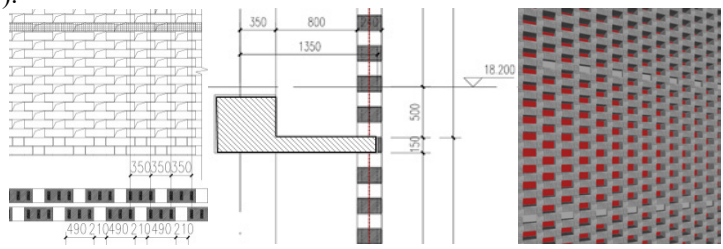

Fig. 7. Node design of aerated concrete block scheme

Finally, GRC curtain wall is chosen as the material of hollow-out effect on the basis of discussion with the builders and constructors. The above problems can be effectively solved and the construction efficiency can be improved by assembling in the factory ahead of time(Fig8).

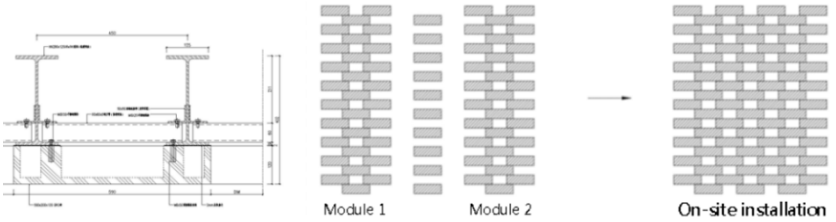

Fig. 8. Node design of GRC scheme

The highest priority aims in the design and construction of industrial facilities have primarily been minimal investment costs, flexibility and expandability of the built structure.[4]GRC is more convenient and flexible in the future equipment replacement. It is more cost-effective throughout the life of the project.In the choice of other nodes and materials, we also through the way of multi-project comparison to achieve the refined design of the building.

4.4 Artistic treatment of industrial architecture

The artistic treatment of industrial architecture can enhance the beauty of architecture, reduce the alienation of industrial architecture and improve the integrity of urban design.

Artistic treatment is more common in many industrial building renovation projects. In this project, the property of the building is still industrial architecture, the design combined with process requirements, then carries on the artistic treatment to the elevation,through the choice of materials for the expression of architectural art.

Based on the stability of architectural form, the design of skin plays an important role in shaping the spirit of place.Structure logic, material logic and structure logic are embodied in detail design. At the same time, the combination of architecture and landscape design forms a space suitable for human activities(Fig9).

Fig. 9. Architecture and landscape environment

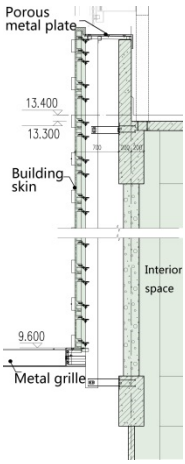

Fig. 10. Double skin node

In the design of this project, the selection of building materials mainly includes several kinds: imitation brick materials, ceramic curtain wall, metal mesh (grid) , glass.

In the brick wall, ceramic plate location, the internal retaining of the original wall maintenance structure, forming a double skin approach.In some existing research papers, double skin can effectively reduce building energy consumption.(Fig10)

In a paper study on the double skin of industrial building reconstruction project，the author set up several different types of external wall form, similar to our design is scenario 2.Based on the total final annual energy use for cooling of the building tab,according to the scenarios 2 which include application of a double skin façade, annual energy consumption for cooling of the building is reduced by 1.77 times, respectively, to 43.46%.[5] (Fig.11)

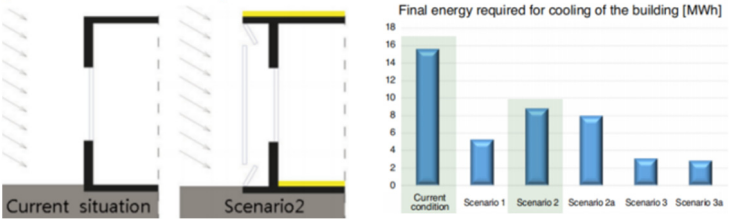

Fig. 11. Energy consumption analysis of double

This project in the choice of materials, not only considering the expression of art, but also reduce the building energy consumption, has more significance.

5 Conclusions

With the development of modern architectural concept and people's attention to the urban environment, the modeling design of industrial buildings is becoming more and more important. Taking a practical project as an example, this paper sums up four design strategies of industrial architectural modeling in cities，and explains how to implement it in project practice.It has the guiding function to the later design practice. And this is different from the industrial building reconstruction project and the industrial building outside the city. Relatively little research has been done on such buildings, which is also the innovation of this paper.

The research of this article mainly carries on the certain explanation to the correlation strategy from the practice one case, it also has some limitations. For different urban environments and different functions of industrial buildings, there will be different design strategy and detail design.In the following work, we will conduct a more detailed classification of industrial buildings, and will continue to explore the practice of different functional buildings.We hope that through the exploration of this article, urban designers can focus on the buildings in the city which is easy to be ignored,and then make a certain contribution to the improvement of the urban environment.

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