Research on urban commercial complex design based on ecological concept-A case study of The Roof in Shanghai

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Abstract. Urban commercial complex, as a kind of composite building with multiple functional spaces, is becoming the main body of the development of urban commercial buildings. It is of great significance to apply the ecological architectural design concept to the design of urban commercial complex. Taking Shanghai The Roof commercial complex as an example, this paper shows the application of ecological building technology and methods in commercial complex, and discusses the theory and strategy of integrating ecological building concept into architectural design, so as to provide some reference for the ecological design of urban commercial complex.

1. Introduction
In recent years, with the rapid development of urbanization and the shortage of land resources, the construction of urban commercial complex has gradually become the focus of urban planning. As the inevitable product of the development of human economic activities, this highly intensive and complex form of integration of multiple functions and business forms can promote the efficient use of land, alleviate the contradiction between the rapid development of the city and the tension of land use, which is the direction and inevitable trend of future urban development. With the development of economy, people's demand for urban commercial complex is higher and higher, and the demand for space quality of urban commercial complex is increasingly apparent. People are not only satisfied with the basic needs of commodity exchange, but also pursue the dual enjoyment of material and spiritual level. The quality of commercial space is as important as commodity, and the improvement and optimization of architectural space quality is particularly important.

As an important medium of interaction between human and nature, ecological architecture is the exploration and return of human to the essence of architecture. The ecological design of urban commercial complex is based on the natural environment, urban style and humanistic characteristics of the commercial complex's geographical location, using the ecological and architectural design theory
to construct the architectural form, space environment and other aspects from the perspective of ecological architecture. Ecological architecture includes ecological concept, organic architecture concept, Regional Indigenous concept, return to nature concept and many other sustainable development architectural concepts. At the same time, ecological building puts forward requirements on the utilization efficiency of building resources, the influence of building, the selection of building materials and so on. This paper shows the ecological design method of Shanghai The Roof project from the perspective of ecological concept, and focuses on the analysis of architectural ecological design technology, so as to provide certain reference and basis for the ecological design of urban commercial complex.

2. Project overview
Shanghai The Roof project is located in the 17/2 block, 45 neighborhood of Huaihai Middle Road, Shanghai. The building is built on the southeast side of the city road adjacent to the city. The entire commercial complex is made up of two buildings. The building blocks are connected through the "half indoor" street. The roof of the building is integrated into the traditional slope roof of the Shanghai law concession, and the traditional building's sloping roof and the trees on both sides of the street are planted. Extracted from the tree elements, the two elements are abstracted and integrated into the architectural concept. The whole building is like the numerous Indus trees surrounded by sloping roofs, which appear in front of people. The rendering of the building is shown in Figure 1. The pictures and materials of this project are from CIFI Group Co., Ltd.

![Figure 1. Renderings of buildings](image)

3. The application of ecological design in the design of commercial complex

3.1. Ecological design concept
The design of modern urban commercial complex can be divided into two categories: one is independent of the environment with the architect's personal style as the core. This type of commercial complex often has a strong personal style. This kind of commercial complex emphasizes identity, such as the white architecture of Zaha, a famous architect. Another kind of commercial complex is the continuation of organic architecture. This kind of complex fully integrates into the local architectural environment. Mr. Jean Nouvel, the designer of the project, was deeply influenced by "structuralism", and advocated that the building should be fully integrated into the local urban landscape. At his request, the project fully considered the block landscape of the French Concession. The street features of the French Concession are shown in Figure 2. The total height of the building was controlled within 24m to ensure that the building would not appear abrupt in the overall block environment. The project softens the boundary between the residential area and the office area, and continues the overall
architectural style of Shanghai's "Lane spirit". The architectural form and facade are dedicated to interpreting the contemporary Shikumen architecture.

Figure 2. French Concession street style pictures

3.2. Ecological facade design

3.2.1. Ecological curtain wall design. In the case of shortage of commercial land resources in urban commercial complex, the space of commercial complex needs to meet the needs of Commerce, office, transportation, greening and other functions at the same time. The project carries out hierarchical landscape organization in both horizontal and vertical dimensions. Through the vertical support system and horizontal bearing system, a large number of planting landscapes are arranged by means of grid, flower bowl system and grid carrier, forming a number of horizontal and vertical indoor gardens, as shown in Figure 3. These landscape spaces provide a place for users to rest and exchange, shorten the distance between people and the environment, and adjust the microclimate. They can not only meet the requirements of diversified landscape layout, but also greatly improve the landscape layout area, solve the limitations of landscape layout, take into account the landscape, environment and economic benefits, and enrich the space atmosphere of the whole project.

3.2.2. Design of flowerpot system for microcirculation of water resources. Due to the huge size of the project, resource saving and optimization is particularly important. The flower bowl system of this project is a small artificial environment. Because of the location and quantity settings, the daily maintenance and maintenance is relatively complex, so the resource microcirculation of the flower bowl system is particularly important. As shown in Figure 4, the flower bowl system on the facade is mainly composed of structural layer, panel layer and flower bowl system. The water supply pipe is embedded in the wall by using the method of embedding the pipeline through the beam, and fixed by the steel structure supported by ultra-high performance concrete. Then it is connected to the top of the flower bowl along the horizontal strut of the flower bowl for spraying. The excess water is discharged by the Φ 20 stainless steel drainage pipe embedded in the flower bowl base. This kind of structural design makes the flower bowl have a certain self-sufficiency, realizes the system water resources microcirculation, and strengthens the management and optimization of the facade landscape.
3.3. Ecological landscape design
As the most direct aspect of ecological design, planting landscape has a significant impact on the ecological environment of the whole building. As far as the function of landscape is concerned, plants themselves, as a landscape, will shape the focus scenery, become the object of people's attention, become the visual focus, and bring some psychological feelings to the viewers. The physical properties of plants, for example, can also regulate the microclimate of commercial complex. The integration of the four-dimensional architectural design concept produces the change of the overall image at the beginning of the project. The core element of "four-dimensional architecture" design is
planting landscape design. Creating a good space environment and comfortable visual effect has become the focus of the landscape design of this project.

As an important part of the whole architectural design, the landscape design of the project involves lawns, shrubs and various large and small trees and ground cover plants. The ingenious and reasonable use of plants will create a comfortable space environment, improve the local microclimate of the commercial complex to a certain extent, and enable users to complete office, communication and communication in a comfortable and pleasant environment Rest and other activities. The landscape design concept of the project divides the landscape types into four themes: meadow, stone cave, tropical forest and sensitive garden. Most of the planting landscapes are seasonal plants, which have excellent inward extension and outward extension. According to the needs of the spatial properties of the floor, intensive planting, committed to creating ecological green indoor corridor. Most of the plants selected in the outer street planting area on the first floor of the project have unified functions. The plants in the outer pedestrian street are mainly purple beads with natural height of 70-80cm and red twig dogwood with crown width of 80-90cm, which are planted in red and green cross with Phormium with simple color and unique optical fiber grass. The plants on the facade of the building are selected to be Rhododendron hybridum with dense and full branches and leaves, 30-40cm crown width, Camellia sasanqua with better lateral branch extension, and low dense Myrtle with flowers and leaves or creeping bright green honeysuckle with better lateral branch extension.

3.4. Architectural color design

With the diversified development of urban architectural forms, the problem of building light pollution is becoming more and more serious. The complex, chaotic, monotonous and abrupt architectural color has been criticized by people, which makes the ecological architectural color design particularly important. Architectural color should be designed reasonably according to the needs of different spaces and people's feelings to interpret the atmosphere of different spaces. The architectural color selection is shown in Figure 5. In order to perfectly integrate the commercial complex into the block environment, the selection of building color fully considers the local block texture, and the color is unified and not monotonous. There is no design for the wall color of the building from the second floor underground to the first floor above the ground. The tone is wood brown, and the color changes naturally from bottom to top. In order to achieve organic unity, the color selection of panels is mainly monochrome. Adjacent panels are set to the same color or similar color. On the whole, the color is gradually transiting from light color to dark color. The color selection of blinds is the same. The adjacent blinds are of the same color or similar color. The color gradient trend of blinds is the same as that of curtain wall, but the gradient degree is slightly weakened, so as to ensure that the color of the whole facade is unified and natural, but not monotonous and tasteless. The color of the outer wall of the flower bowl should also be monochrome, which should be consistent with the color of the curtain wall behind, and one or two color numbers brighter than the color of the curtain wall.
4. Concluding remarks
Commercial complex, as a composite building integrating commerce, office, entertainment and other functions, is the focus of urban development. While meeting the economic benefits, it is of great significance to pay attention to the ecological design of the building, integrate the ecological design concept into the architectural design, and highlight the ecological benefits of the commercial complex. By showing the ecological design technology of Shanghai The Roof commercial complex, this paper discusses the design method of ecological architecture, which provides a reference for the ecological design of China's commercial complex in the future.

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