

Discussion on Humanistic Design Method of Atrium Space in Modern Architecture

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Abstract—This article explores humanistic design method for atrium space of modern architecture from the perspective of users. It develops from the atrium space of pure functionalism to organic ecological direction. This article deeply researches on aspects such as atmosphere building, ecological and energy saving and ecological intelligence, systematically summarizes on its pattern of manifestation and design methods, puts forward humanistic design methods for modern atrium space and forms relatively systematic theory related to the development of users of atrium space, in order to provide effective methods for the creation of future atrium space that combines high technology and high emotion.

Keywords—atrium space; humanistic; ecological

I. INTRODUCTION

Humanistic design is widely used in all fields of design. The people-centered design is not a theoretic slogan but should be rooted in the hearts of architects. The atrium space design needs to meet people's physiological needs as well as consider people's psychological feelings and truly achieve the integration of high technology and high emotion in atrium space.

II. CREATION OF ATMOSPHERE OF ATRIUM SPACE

In atrium space, the light, color, sound and materials saw, heard and felt by people form the objective material environment of the space. The atmosphere of atrium space is the result of people's senses produced after being influenced by these objective environments. Therefore, when we create the atmosphere of atrium space, we design on the basis of these spatial elements.

A. Space Form

Different atrium space forms have entirely different space style. Pictures composed by geometric figures such as square, round circle and polygon often give people serious and solemn feeling, while irregular spatial forms will bring us natural and flowing space perception. Closed space can create introverted and stable atmosphere, while open type of space gives us open and free impressions. Large scale spaces make us feel grand and open. Towering spaces make people feel solemn and respectful and mysterious. Low spaces make us feel amiable and warm. Most contemporary atrium space is compound space that combines various space forms and it is also the complex of large spaces and small spaces. We

need to choose the most appropriate space forms according to space atmosphere that we hope to create and then create rich space aggregation in combination with small spaces.

The indispensable element in space form is spatial decoration, including whether the wall space is empty or full, the form of the skylight, the fluctuation of the ground as well as their colors and materials, etc. As component elements of space form, they cannot be designed in isolation, but should be designed on the basis of space atmosphere. The design of lighting, selection of lights, layout of furniture and greening treatment should start from the whole view of space and avoid the situation of blind arrangement because of lacking inner connection. Good space decoration can adjust proportion of the space and foil space atmosphere.

B. Materials and Details

Materials and details are important elements in creating atrium space. They are the keys to form the whole atmosphere of atrium space. Space interface felt by users when they get around in the atrium space is the general effect formed by combination of material texture, texture lines and color, light and shade and rhythm.

The difference of materials will directly affect people's vision and touch and bring us entirely different perceptual experience and then produce different spatial effects. Firstly, the color and texture of the material decide the first impression. Secondly, these sensory impressions will produce a kind of consciousness and association in people's heart. This reflection is people's psychological feelings toward materials. For example, the feelings brought by concrete and wood are cold and warm, which are completely opposite.

Materials can be directly touched by users in atrium space. In order to make the space have direct relationships with people's life, it is necessary to pay attention to details in the space. Direct feelings showed by key details and symbolic meanings implied by details will directly influence the whole space atmosphere.

C. Natural Medium

Plants, lights and water in nature are indispensable factors in space environment and play an important role in the creation of space atmosphere. These natural factors have obvious timeliness and regionalism. They will produce

obvious differences as time goes by, and create unique charm of space and enrich the spatial experience of atrium space.

1)*Plants*: Chinese people often endow plants with some special meanings. For example, in China, plum blossoms, orchid, bamboo and chrysanthemum represent different personalities and levels of gentlemen, which can fully reflect the regionalism of building materials. Each country has its own unique plants. Properly using plants can embody characteristics of regional culture. Besides, the shading of plants can reflect space levels. Some are hidden and some are exposed, giving people the feeling of the combination of the virtual and the real.

2)*Water*: The color and form of water can bring people entirely different space feeling. Water is the best space element that can bear emotions. Water is changeable, such as flowing water, still water, roaring water and quiet water, etc. Water can bring us direct visual stimulation and make people produce endless associations and memories in their heart. Different water can create entirely different space atmosphere.

3)*Sound*: The feelings brought by sound for people are unique and strong. Sound can strengthen people's experience for space and trigger more memories and imagination. If we can hear sounds of the wind and the pitter-patter, it is easier for people to enter the quiet and comfortable atmosphere. The effect of silent space is a kind of special phenomenon in building space. It not really has no sound, but uses slight sounds to contrast to reach the silent effects.

D. Space of Light and Shadow

The relationship between light and shadow can highlight the connections in elements in the space. It integrates elements in the space together and even produces new situations to make the space have richer connotations. The spaces of light and shadow often include visual light and shadow, tactile light and shadow and psychological light and shadow.

Visual light and shadow refers to that the form, strong and weak of the light and shadow will change as time goes by, and then form beautiful pictures with many changes. The stronger the effect of light and shadow is, the more it can embody the volume and space inside the building. Tactile light and shadow refers to the changes of the temperature of light that can be felt by people through the touch of skin. The warm feelings brought by direct light make people feel satisfied. The cool feelings brought by shadows can also pleasure us. Psychological light and shadow refers to the influence brought by light and shadow for people's psychology. Light indicates hope and warm, while shadow often gives us serious and depressed feelings. We should design the relationship between light and shadow according to the atmosphere and keynote of space. Artful space design can catch the slight changes of light and shadow and record the passing of time.

III. ECOLOGICAL ENERGY-SAVING STRATEGY OF ATRIUM SPACE

Atrium space is a relatively stable ecosystem, and it is the main space to adjust the whole climatic environment of the building. Doing systematic research on it helps to greatly reduce the overall energy consumption of the building. The ecological energy-saving strategy of atrium space mainly includes the following aspects:

A. Selection of Structure and Material

In the process of design and construction, the selection of structural forms and materials is an important link in ecological design of atrium space. The structural rationalization of atrium space is under the premise of ensuring the safety of the main building, uses the most reasonable structural system to realize the reasonable design for structure of the building, reduce the use of building materials to reduce energy consumption and meet the principles of sustainable development. The optimization of materials means choosing green building materials in atrium space. Its main features include the following aspects: easy to recycle; reduce the environmental pollution to avoid greenhouse effect; save resources. Meanwhile, because different areas have different preferences for geographic resources and materials, choosing native materials that have regional characteristics can better reflect the regional features of buildings.

B. Space Interface

The energy conservation of space interface of atrium space is mainly reflected on its vertical interface. It is essential to use some advanced technologies to improve the exterior protected construction or innovate on the basis of traditional technologies to realize the goals of energy conservation. Common energy-saving techniques include:

1)*Double-deck cuticle system*: Glass curtain wall has become the most popular form of external wall in atrium space because of its openness. With the outbreak of energy crisis, people have increasingly realized the serious defects of glass curtain wall in the aspect of energy consumption, so they begin to research on its technological innovation. The most common is "double-deck cuticle system", which means that the cuticle systems of building include a layer of heat-protecting glass, a layer of double-deck cuticle formed by simple exterior glass and the porous ventilation layer between them. It has good thermal property. Its operating principle is to use the difference of pneumatic pressure to inhale the exhaust gas in the room to the air-filled cavity. After absorbing energy from the sun, it becomes warm and rises naturally and is finally exhausted to the outdoor, thus taking away the exhaust gas and thermal energy. In summer, we can let the air flow into the air-filled cavity to take away the heat inside the door. In winter, after being closed, it has good thermal property and sound insulation property and reduces the energy cost that used in the warm of winter and the cooling in summer.

2)*External sunshade to save energy*: The solar radiation in open position of the atrium space is the main reason to

cause energy consumption. The sunshade is the important part of energy conservation in atrium space. Although there are external sunshade and internal sunshade, external sunshade can better meet the requirements of shielding the sunlight and avoid the glare when people look far into the distance. The external sunshade that formed by traditional reinforced concretes will leave us impressions of poor appearance and difficult construction. But the design of external sunshade is not limited to this. In modern times, many sunshades are formed by perforated plates and dense metal nets, with light weight and the performance of dispersing and guiding glare and extremely beautiful forms.

C. Natural Elements

The natural elements most commonly used in ecological design of atrium space are ventilation and greening. The design with ventilation and greening can greatly improve the climatic environment of atrium space.

1) *Ventilation design*: The ventilation principles used in atrium space often include two kinds: One is the wind pressure ventilation. When the wind directly blows to the building, the air pressure at the windward side is higher than the barometric pressure and then forms the zone of positive pressure, and the air pressure at the leeward side reduces and becomes the zone of negative pressure. Thus the pressure difference produces at both sides of the building. The air inside the building can flow naturally. The other is thermal pressure ventilation. It is the stack effect commonly referred by people. Because the temperatures inside and outside the door are different, the air densities and air pressures of them are different, too. If we open an exit under the atrium space, cold air outside the door can enter, and the hot air inside the door will be exhausted through the upper exit. The bigger the difference of indoor and outdoor temperature is, the stronger the effect of thermal pressure will be.

2) *Greening design*: Hanging garden is a kind of ecological design method of atrium space. Its interior greening can improve the micro environment of the building, save energy consumption of the building and have decorative function. Hanging garden provides places for people to relax, entertain and do other activities, alleviate people's feelings of fatigue after long-term indoor work. The common hanging gardens have superimposed type and courtyard type. The superimposed type of hanging garden superimposes the units in the air that have gardens to vertical space. Because each unit often has spaces of two to three layers, the design is also relatively free and flexible. It can be well-proportioned and has plentiful layers after dispose on facade.

Roof garden: The roof is the fifth elevation of building and the non-ignorable link in urban construction. Foiled by the building form, the roof garden mainly has the following ecological features: Roof greening improves the whole ecological environment of the city and increases the green area in the city; the construction of roof garden makes people have more opportunities to contact with nature and produces colorful and vivifying building space; most of the traditional roofs use grey concrete and black asphalt, which leave us bad impressions when we overlook it. The introduction of

roof greening enriches the overall landscape of the city and improves people's visual environment.

D. Utilization of Renewable Energy

The renewable energies in atrium space include solar energy, geothermal energy and biological energy source, etc. The utilization of them reduces people's dependency on non-renewable energy resources such as fossil energy.

For the utilization of solar energy in atrium space, there are two kinds of the most common forms: Solar power generation. It turns solar energy into electric energy through optoelectronic system for the application inside the building. This kind of optoelectronic system can be applied to the facade or roof of the atrium building to serve as the photoelectric thin plate of its overlying strata as well as the layer of maintenance structure of the building. It can resist the erosion of environment and provide partial day lighting for the building. It can be made into different sizes and forms and has multiple uses, such as exterior facade, sunshade and exterior window, etc.

Geothermal energy can be obtained by using local materials. It is a kind of well-adapted and sustainable environmental-friendly energy. The common form is the geotherm in soil. Almost all the temperature of soil at shallow layer at any place can maintain at 10 to 16 degrees. We can use heat pump system. In winter, we can take soil as the heat source to drive heat pump system to warm the building. In winter, use heat pump system to disperse the excessive heat to the soil.

Biological resources can be used to supply heat, generate electricity and make fuels, etc. As the most extensive biological energy, wood is used to supply heat all the time. Besides, there are many other biological resources, such as industrial and agricultural wastes, household and industrial refuses. The advantages of biological resources include: most of the energies can be turned into thermal energy; little discharge of poisonous gas, and there are only discharge of slight flying ash; environmental and renewable, high economic applicability; has close relationships with city life because all kinds of dead branches and household refuses are easy for us to use local materials.

IV. ECOLOGICAL INTELLIGENT STRATEGY OF ATRIUM SPACE

At the present times, intelligent technology and ecological technology combine closely. Using intelligent management system, equipment technology and exterior protected construction to create comfort and safety, ecological and energy-saving atrium space environment can meet people's requirements for the sustainable development of living environment as well as expand the area of architectural development.

A. Intelligent Management System

Intelligent management system is equal to the neural center of control system of the overall built environment. It can collect information through sensors spread all over the

atrium and make corresponding feedback control after analysis. Complete building management system can detect the changes of climatic environment, monitor and control the operation situation of regulating system of the built environment, and guarantee good ecological environment and lowest energy consumption inside the building.

B. Intelligent Control Equipment

The common intelligent equipments in atrium space include:

1)Lighting control equipment: Intelligent lighting system is driven by light sensor inside the building, adjusts the lighting workload by contrasting the internal illumination level sensed by the sensor and the illumination level required by normal use.

2)Solar control equipment: Intelligent sun-shading system can trace the changes of the sun in every day, and adjust sun-shading equipments according to real-time location of the sun. These equipments are put into the cavity with double-deck cuticle. They are used to absorb heat in summer and serve as thermal storage devices in winter.

3)Ventilation control equipment: Intelligent ventilation system can adjust the ventilation through adjustable components in building components such as retractable roof, motorized skylights, airflow windshield to create ventilation environment that is suitable for residents. It can decide the time to start ventilation equipment and then maximize the natural ventilation and minimize energy consumption. Meanwhile, it can close the ventilation system when the weather is bad or there is no user.

4)Temperature control equipment: Intelligent temperature-controlled equipment uses computer to control geothermal exchange device, underground water cooling system and solar energy heating device according to environment temperature to achieve automatic adjustment of thermal environment of atrium space.

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