On Architectural Shading Technology

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Abstract

shading is not only an important part of the building but also an important measure to improve the energy saving. The analysis in this paper started from the classification, the material selected, the development trend, etc. of architectural shading and in combination with relevant examples to make a preliminary study on the architectural shading so as to promote the development and promotion of green architectural shading.

Keywords

architectural shading, classification, material, development trend.

1. Introduction

In the world today, as the resources on the earth are decreasing, more and more attention is paid to the saving and efficient use of resources. The construction industry consumes a large proportion of energy. According to statistics, the air conditioning load per square meter of buildings in China is up to 50-200W/m^2, resulting in great waste of energy. As the first layer of system in the exterior of the building, the shading can reduce solar radiation and adjust indoor temperature. A good shading system can reflect most heat, effectively reduce the use of air conditioners, and decrease energy consumption. At the same time, the shading can enrich the shape of the building facade and enhance the artistic effect.

2. Types of shading

2.1 In terms of form of shading structure

In terms of the form of the shading structure, the architectural shading can be classified into horizontal shading, vertical shading, integrated shading and baffle shading. See Table 1 for the contrast of the four modes of shading.

2.2 In terms of positional relationship between shading system and window

It can be classified into exterior shading, interior shading and middle shading. The interior shading refers to an indoor shading system, including curtain, roller blind and venetian blind, which can be chosen by users according to their preferences. The middle shading refers to shading facilities between two layers of glass and the overall design of the entire window. The exterior shading refers to shading facilities designed outside the window, which can effectively shield the sunlight, with best shading effect. Relevant data show that the building with exterior shading can shield about 70% of the heat more than that without exterior shading.

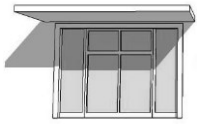
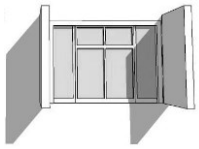
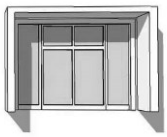
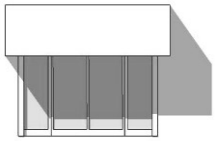
2.3 Green sunshade

Green sunshade is the approach of using green plants to replace sunshade facilities, which is both economic and environment-friendly（Figure 5）. The methods of green sunshade include planting green plants outside a building, roof greening, and others. Tall trees are applicable for planting outside a building. When carrying out green sunshade, lighting and ventilating of the building shall be taken into account. Trees should be planted at a distance from the windows of the building to ensure the lighting of the building. At the prevailing wind directions around the building, trees should be planted reasonably and should not be over crowded to ensure the smooth ventilating of the building.

Climbing plants, like creeper, morning glory, etc. could be planted along the outer wall of the building. These plants can not only shadow the building, but also produce heat-preservation effect.

Figure 5 Green sunshade

Table 1 Contrast of Four Modes of Shading

Type	Horizontal shading	Vertical shading	Integrated shading	Baffle shading
Location of visor	South window	Northeast or northwest window	Southeast or southwest window	East or west window
Advantages	Effectively shield the sunlight with large elevating angle; enhance the horizontal sense of the building facade; increase light effects	Effectively shield the sunlight with small elevating angle from both sides of the window; enhance the vertical sense of the building facade; increase the dynamic sense of the building	Both horizontal and vertical, with better shading effect	Effectively shield the sunlight with small elevating angle shining on the window in the forward direction; can be designed in combination with veranda or balcony
	 Figure 1	 Figure 2	 Figure 3	 Figure 4

3. Shading material

3.1 Shell fabric

Soft fabrics such as glass fiber and polyester fiber are widely used now, which can be treated due to different requirements for different effects. For example, some fabrics has unilateral permeability, people inside can see the outside, but people outside cannot see the indoor scene; some fabrics can be treated in color, the light color is outward to reflect sunlight, and the dark color is inward for heat preservation and insulation.

3.2 Metal material

The architectural shading is usually made of aluminum alloy that has high climatic adaptability, high plasticity and various shapes. The south facade of the Arab World Institute designed by Jean Nouvel consists of hundreds of metal squares. Each square is a sophisticated “lens” which is controlled by the photosensitive conductor so that it can open and close according to the sunlight intensity to achieve effective shading.

3.3 Glass coating

Coated glass can be used for shading, which can effectively reduce ultraviolet rays but at the same time has an impact on the lighting. Heat-reflecting glass has a surface coated with metal, nonmetal or oxide, etc., which, however, has a low transmittance. L-OWE glass has a surface coated with very thin metal oxide. Coated glass has very low radiance, but L-OWE glass has high transmittance and less heat loss.

Table 2 Contrast of Indoor Heat Gain of Several Shading Materials in Summer

Type	Without shading	Visor	Indoor fabric curtain	Colored glass
Indoor heat gain in summer	100%	30%	60%	55%

4. Development trend

At present, the design of architectural shading is developing along the green and energy-saving way, and the architects are also exploring new ways of shading. The combined design of architectural shading with lighting, ventilation and solar energy better integrates the shading system into the building.

4.1 Intelligent shading

In order to maximize the shading effect and enhance the adaptability of the shading structure, the architectural shading can be designed in combination with the intelligent system, such as the installation of wind and rain remote sensor to adjust the angle and length of the shading structure according to climate, weather, etc. and the installation of temperature remote sensor to adjust the shading structure according to the temperature. What's more, the time motor control system can adjust the angle of the visor according to the stored sunrise and sunset time in different seasons to increase indoor comfort.

4.2 Integrated design of shading and solar energy

Figure 6 the photovoltaic shading

At present, solar technology is advancing day after day and the combination of solar energy and shading is an effective way to save energy and improve indoor comfort. The solar cell is also known as the photovoltaic cell. The photovoltaic shading is to combine the photovoltaic solar cell with the shading system so as to combine shading and generating(Figure 6). The combined design of photovoltaic panel and shading facility can effectively solve the problem that solar equipment occupies large space; the large shading panel area can independently provide the building with power, energy saving and high efficiency. To avoid exposure to light, the photovoltaic panel is often designed as foldable.

5. Conclusion

Frequent rough weather warns human that the living environment is seriously damaged. The immoderate use results in exhausted natural resources. The construction industry consumes a large proportion of energy so that the effective energy saving measures must be taken, and the shading should be designed in combination with lighting, building facade and solar energy for the efficient use of energy. In addition, the design need to consider the shading device's impact on ventilation,

lighting, line of sight, etc. Only in this way, the building can have better sustainable development and achieve harmonious and unified development of building and ecology.

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