

Energy-saving Technology for Sunshade in Natatorium

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Abstract: *In the design of natatorium, the control of natural light should not be overlooked. Like most of the buildings, natatorium should adopt a reasonable way or combine several different ways for solar shading so as to reduce indoor glare and surplus heat. Solar shading can block light, reduce solar radiant heat, and adjust the distribution of natural light.*

Keywords: solar shading; interface; energy-saving.

1. Introduction

There are two ways of solar shading in natatorium – outdoor solar shading system and indoor solar shading system. Outdoor shading system blocks sunlight before it comes inside. It can prevent indoor moist air from corroding sunshade components. Outdoor shading system is very effective in that it can block both light and heat. However, the exposed sunshade components of outdoor system may affect the effect of building elevation. So, in setting outdoor solar shading system, designers should plan it together with the effect of building elevation.

Indoor solar shading system mainly uses sunshade, shading curtains and coated lighting surface. The use and maintenance of the system is easy and the investment is low. But its shading effect is not as effective as outdoor system, since heat has already come into the house through glass. Its advantage is that it protects indoor privacy and improves indoor space quality. This system is suitable for natatorium located in cold areas or natatorium with low standards.

Other shading methods for natatorium include greening shading, building self-shading and geomorphic shading. Greening shading and building self-shading are more commonly used. Because of its large scale, natatorium is often constructed on flat area. Therefore, geomorphic shading is rarely used.

1. Outdoor Solar Shading

1.1 Component shading

Based on the forms of solar shading components, they can be divided into horizontal shading, vertical shading, synthetical shading and baffle-type shading. The selection of sunshade components depends on their respective features.

- (1) Horizontal shading – it is the most simple and effective shading method, which is suitable for southward high-angle shading. It mainly includes overhang shading, grating (Fig 1) and reflector (Fig 2).

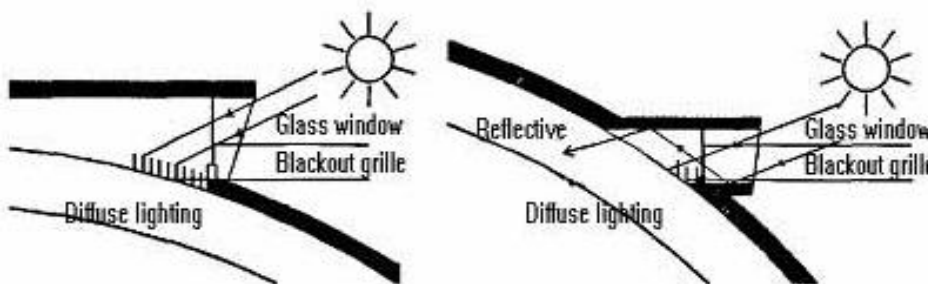


Fig 1 : Diagram of grating shading

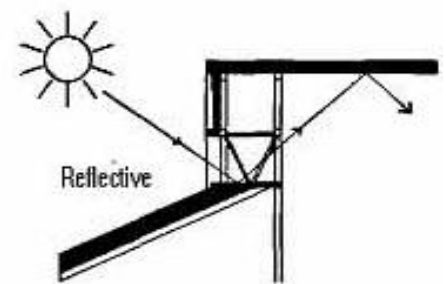


Fig 2: Diagram of reflector

- (2) Vertical shading – it is an effective supplement to horizontal shading. It can block inappropriate openings to control low-angle light. It is suitable for shading of the east side and west side. But vertical shading is not good for the channeling of bounce light. It is generally used with horizontal

shading. Vertical elements (pillar, wall) or vertical blinds will be installed in a large scale.

- (3) Synthetical shading – the combination of horizontal and vertical shading. It should mind the control of glare, guide effective bounce light and reduce thermal radiation.

In terms of the installation methods of shading equipments, it can either use fixed sun louver or flexible sun louver. Through manual work and mechanical operation, partition boards and mobile eggcrates can be moved to control and adjust the photopermeability of the glass. With light screen or partition board on the glass, glare generated from direct light can be avoided. For example, to control the intensity of indoor light, space enclosing structure of Jinan Olympic Center Natatorium (Fig 3) is in the shape of willow leaf. It takes advantage of natural lighting and achieves the desirable effect of glare proof. Many lighting windows have been set on the elevations and roofs of the building. In addition, to increase the area of natural lighting, several patios for lighting and ventilating have been established based on the terrain. Shading coefficient of this characteristic outdoor shading system is 0.4 – 0.7. This design greatly reduces the energy consumption of air conditioning and effectively prevents glare.



Fig 3: Shading System of Jinan Olympic Center Natatorium

1.2 Greening shading

Greening shading includes wall vertical greening, roof greening and outdoor plants. Because of its demand for large space, natatorium has big roof and wall area. Therefore, applying vertical greening and roof greening would achieve good shading effects. Fig 4 shows the design of grass roof and glass louver in Brazil Bessie Stadium. Due to the peculiarity of natatorium's structure and materials and the technological limitation, natatoria of this type are few. In addition, since natatorium is generally placed within large sports center, its greening should be planned together with the whole layout. The west part and south part are preferable location of greening for shading effects.



Fig 4: Grass Roof of Brazil Bessie Stadium

2. Indoor Solar Shading

The most common shading method used in medium and small natatoria is the setting of sunshade curtain. There are two types of sunshade curtain – manual operated type and power-driven type. Because of the large space of natatorium, power-driven type is more often used. Curtains can be closed during competition and drew aside after competition to let in natural light and reduce artificial lighting. This will reduce energy consumption used for illumination. However, the effect of indoor shading is not as good as that of outdoor shading. Indoor shading may reflect and absorb some light and increase indoor cooling load.

3. Self-shading of the Building Surface

3.1 Coated glass shading

The lighting surface of natatorium can use coated glass for shading. Coated glass is convenient in construction and low in cost. Besides, it will not affect the image of elevation and indoor design. And it will not generate the problem of the corrosion of shading components by moist air in natatorium. The coating can reflect infrared ray to the outside. It can also insulate the heat absorbed by glass. Heat are prevented from coming through, the indoor thermal environment can thus be controlled. Glare and chromatic dispersion will also be reduced. Moreover, the working load of air conditioners and the equipment investment will be reduced. Money and energy can be saved.

3.2 Membrane shading

Natatorium can use membrane structure and membrane roof, and shading can adopt the method of dot plating. The density of dot on the membrane should be based on the direction and indoor lighting measure. In this way, different shading coefficient can be obtained and the indoor light and heat can be controlled. For example, National Natatorium (Water Cube) applies the advanced material ETFE (Fig 5). For shading effects, 16mm silver dots with density of 10%, 20%, 30%, 50% and 65% are coated. Its function of light insulation and reflection will block unnecessary heat and light. Through the adjustment of dot density on ETFE, we can get different shading coefficient to control the amount of light and heat coming through. Light on the north elevation is little, so the dot density should be relatively low to let in more light. While on the west and east elevation where light is strong, the dot density should be higher. Through a research on the Beijing's climatic data of recent 30 years and a precise calculation, dot area of each membrane has been decided. The dot area on the south elevation is below 50%, and the number is around 60% on the west elevation. This design can block 70% of the sunlight and the effect of solar shading will be achieved.

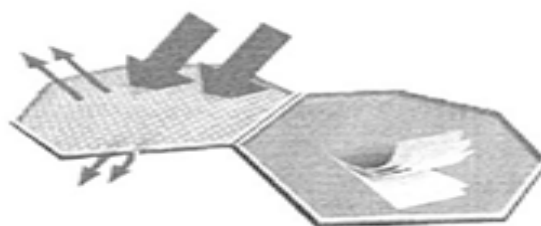


Fig 5: Membrane shading of Water Cube

3.3 Minitype blinds shading

Minitype blinds can be set between glasses. Through the control of blinds angle, the effect of shading and light reflection will be achieved. At night, blinds can shield the window hole and reduce the leakage of light and heat. They are generally set between double-skin façade. With the help of ventilation facilities, the purpose of energy preservation will be achieved.

4. Conclusion

Natorium is characterized by wide span, large scale and high demand of indoor environment. Therefore, in summer, the energy need for air conditioning is huge. Based on the climatic features and the architecture type, we can devise a reasonable shading plan to save energy, optimize indoor luminous environment, and improve summer thermal comfort degree.

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Author Profile



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