Chapter 94
Impact of Different Placements of Shading Device on Building Thermal Performance

Hong Soo Lim[1], Jeong Tai Kim[2], and Gon Kim[2,*]

[1] Department of Architecture, Kangwon National University, Chuncheon, Gangwon-do, 200-701, South Korea
[2] Department of Architectural Engineering, Kyung Hee University, Yongin, Gyeonggi-do, 446-701 South Korea
youaresun@gmail.com

Abstract. In America, the method of receiving the certification for environmental architecture through renovation is activated but in South Korea, it is difficult to find except for the minor renovations occurred to change the previous construction material built in early 2000. It is more efficient to raise the value of an old building by putting over a double skin façade on the outside to make the building more energy efficient than to build a new building. Thus, in this study the energy efficiency of the shading device, the most frequently used composition in designing the double skin façade, is evaluated. Also, the energy efficiency of the typical horizontal blind and the shading device with V-shape slat were compared and used to evaluate the cooling and heating load according to the position changes

1 Introduction

Nowadays, in South-Korea, the restoration movement of 4 major rivers, Korean New town project and the relaxation of the real estate regulation project have been conducted for the real estate activation. However, the value of real estate has been decreasing until now, and as a result, household' loan on real property has been increased. Consequently, it increased 'house poor' and bankruptcy of construc-tion companies. Therefore, this study suggests a new type of construction such as combining shading devices and double skin façade. This method does not destroy the existing buildings nor built new one as new-town project or reconstruction. This research proposes having new outfit in existing buildings attaching new envelopes with shading device to increase the value of buildings and reduce energy consumption.

2 Energy and Daylight with Shading Devices

The most important objects in raising the energy efficiency of an old building are the double skin façade and the design of shading device, by putting on a double skin

* Corresponding author.

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façade and creating a new exterior to improve not only the technical performance but also the aesthetic aspect.

Recently, many researchers have studied on the green building and the demands increased continuously. Although there are diverse existing standards, the daylight is the base of the green construction. The daylight which has an effect on the zoning that divides perimeter and core is one of the important elements in the environmental architecture. Since energy consumption, occupant's satisfaction, productivity and health depend on which shading device was used on the envelopes.

Also, Solar radiation and the outdoor temperature are essential factors influencing the optical and thermal conditions in a building via thermal gains/losses and incoming light. Commonly, thermal and illuminance are not in coordination and hard to control appropriately [1] Direct sunlight for room lighting is hard to be applied to all structures because its value of illuminance is too high and cause several problems such as overheating, uncomfortable visual environment and view performance. For these reasons, use of shading devices is coming to the fore again. External shading devices have been used extensively in residential and commercial buildings to control the amount of daylight coming into buildings. They are designed with the solar geometry in mind and their configurations are closely related to the sun path. Also, internal shading device is useful to control daylighting performance and shown good maintenance. Especially, venetian blinds reduce glare and provide the view to outdoor, by adjusting slat angles. Figure 1 shows the tendency of illuminance with different slat angles in summer and winter. The result shows that slat angles allow daylight to be transmitted with venetian blinds. By adjusting slat angles, daylighting

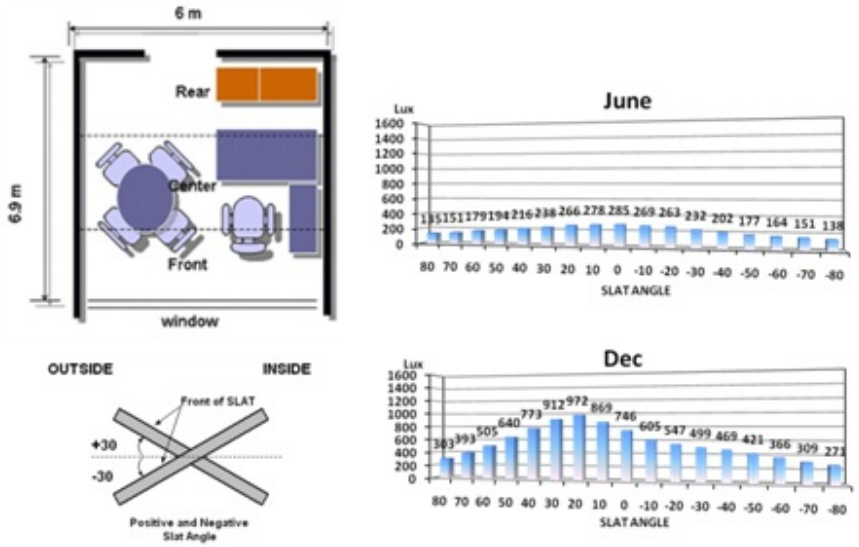

Fig. 1. Illuminance with slat angle in different seasons

performance is changed in the rear space. As a result, the blind slat of 20° might be the most appropriate angle of slats.

In this study, the objective is to use the shading device with V shape slat which blocks and transmits light to compare the result of cooling and heating load with that of the horizontal blind system. As for the variables, horizontal blind which is typically used in double skin façade was compared to the shading device with V-shape slat.

Since the energy performance could change depending on the position of shading device installation, the case was divided into three categories such as indoor, outdoor and intermediate space. In Figure 2, it shows the exterior and the installation location of the V-shape slat.

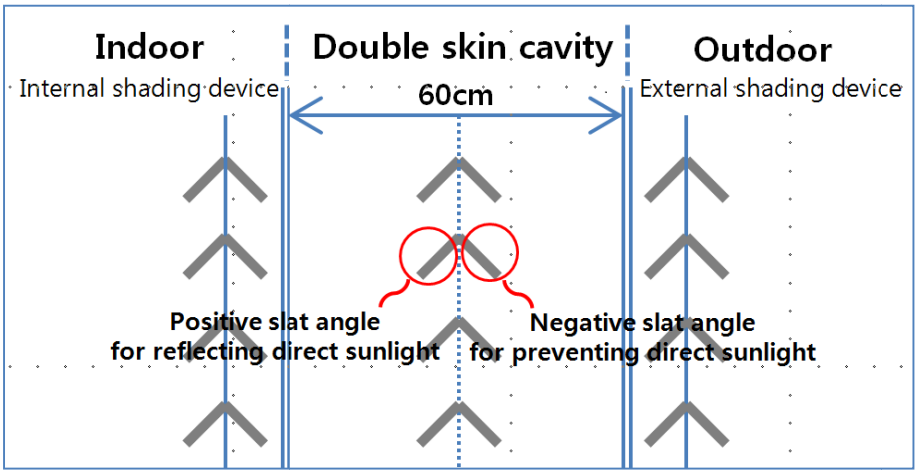

Fig. 2. V-shape slat and Installing position

3 Methodology and Analysis Tool

IES_VE (Virtual Environment), the building energy simulation program, integrated with various 3rd party applications carried out the thermal performance of the curtain wall configuration. Especially, Apache-sim is used to calculate the heating and cooling load in the process of the energy analysis.[2] In order to reduce the data noise and for more effective simulation, three layers have been equipped to mediate the negative impact of sol-air temperature with direct solar radiation. Also the final outcome of the second floor was suggested to eliminate the impact of geothermal heat. For performing simulation, we had to know the U-value of constructed material properties. The information is shown in Table 1. The dimension of experimental space is 8m X 8m with south-facing window.

Table 1. Boundary condition for Virtual Environment simulation

Construction	Description	U-value (W/m^2K)
Exposed floor	Concrete(180mm)+bid-insulation(65mm)+cellular-concrete(40mm)	0.41
Ceiling	Concrete(180mm)+bid-insulation(65mm)+cellular-concrete(40mm)	0.41
Internal patition	Plaster(13mm)+brick(105mm)+plaster(11mm)	1.69
External wall	Concrete (200mm) + bid-insulation (75mm)	0.39
External glazing	Clear glass(6mm+6mm) double layers	1.46
Double-skin glazing	Clear glass(6mm+6mm) single layer	2.74

4 Thermal Performance with Shading Device

The result of the simulation is as shown in Figure 3. When shading device with the V shape was installed indoor, the estimated cooling load was 0.79 kWh/m^2 but when the double skin façade was installed outdoor the result was reduced down to 0.65 $kWh/m^{2.}$ With the reduction of half the cooling load, the result indicates improved cooling load in case of outdoor installation. On the other hand, heating load showed different results. When indoor, the measurement was 1.8$kWh/m^{2,}$ whereas, the result increased up to 10 times when installed outdoor. As a result, when the shading device is installed at double skin façade, it is possible to control the cooling and heating load appropriately. In comparison with the typical horizontal blind used in intermediate space, there was no particular difference in cooling and heating load but the amount of reflection light inflow increased due to the positive angle slat.

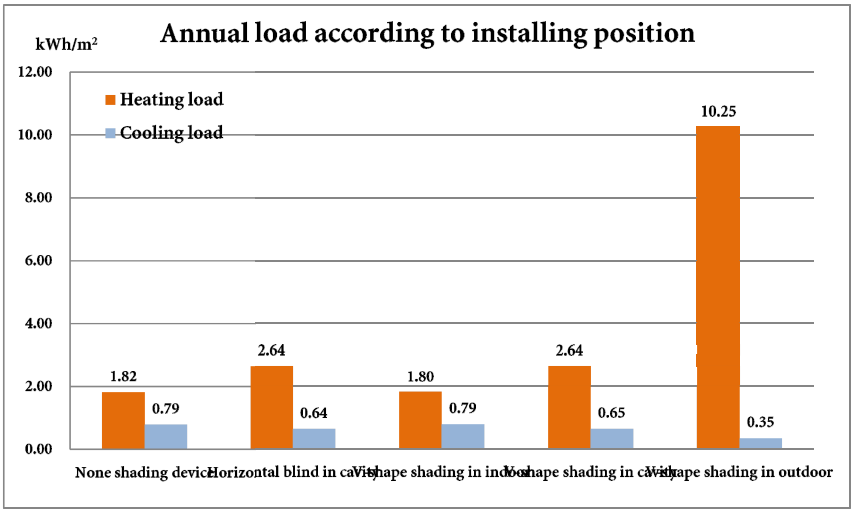

Fig. 3. Comparison of annual heating and cooling load

5 Conclusion

This research is aimed at exploring the usefulness of V-shape slat on the energy consumption of office building module in South Korea. The IES_V.E(Virtual environment) software was used to predict the energy consumption of different conditions. Consequently, it showed no particular difference in cooling and heating load both with the v shape blind and horizontal blind.

However, in case of V-shape slat, due to its slat angle which transmits the daylight, it is expected to have better result than with the horizontal blind. In analysis of V-shape blind according to its installation position, it had advantages in cooling load because it doesn't inflow long wavelength infrared light but it had disadvantages regarding the heating load of indoor shading device in winter.

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