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COMPARATIVE DAYLIGHTING PERFORMANCE OF DIFFERENT TOPSIDE LIGHTING SYSTEMS BY LIGHTSCAPE

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ABSTRACT:

The use of daylighting has grown in recent years, due to both of enlivenment of indoor environments and reduction possibility of the electric lighting energy consumption. Monitor, sawtooth and sawtooth of the topside lighting systems is less possible for glare and more light compared to sidelighting. The objective of this study is to compare daylighting performance of different topside lighting systems using Lightscape program. Three types of topside lighting systems (monitor, sawtooth, sunscoop) were compared. Light factor was used as the performance parameters. The sawtooth window system has shown the most efficient daylighting performance under clear sky.

Conference Topic: The Earth/Desert/Green and Sustainable Buildings

Keywords: Lightscape, Topside lighting, Daylighting, Illuminance, Light factor

1. INTRODUCTION:

The provision of daylight in a building is an important factor in interior design, energy use in a building, the general comfort, well-being of the occupants. Topside lighting systems provide a more lighting into a room than side lighting. It can provide relatively uniform light distribution. This study aims to compare the daylighting performance of different topside lighting systems using Lightscape program.

2. DESCRIPTION OF THE METHOD:

Room geometry was defined with a rectangular floor area 144m² (12m × 12m), a room height of 4m, and a window area of 14.4m² (1/10 floor area). The test model is located in the Yongin-si (latitude 37°, longitude -127°) near the Seoul. Figure 1 shows the isometric representation of the three systems (sunscoop, monitor and sawtooth system). Interior illuminance levels on the horizontal were measured at a floor plane. Twenty five floor plane illuminance sensors were located in a 5 × 5 grid in test room. The test room are oriented south

direction. This study was carried out 21st October at 9:00am and 12:00pm. The parameters setting for Lightscape simulation is described in Table 1.

Table.1 A Comparison between different projects

Components	Material	Reflectance
Ceiling	White Paint	0.95
Floor	Ivory Paint	0.50
Wall	Ivory Paint	0.67
Roof	White Paint	0.95
Window	-	0.05

3. RESULTS AND DISCUSSION:

Figure 1 shows the external illuminance. The highest outdoor horizontal illuminance was 75,998[lx]. The lowest was 19,550[lx]. Fig. 2 and 3 show minimum, maximum and average values obtained under clear sky conditions for each different system. The average light factor at 09:00 am was 4.06% with monitor, 5.20% with sawtooth and 2.77% with sunscoop. Also, the average light factor at 12:00 pm was 7.76% with monitor, 8.33% with sawtooth and 0.77% with sunscoop. The results showed that the sunscoop system light factor at 9:00 am and 12:00 pm produced 2~10 times lower than monitor and sawtooth systems.

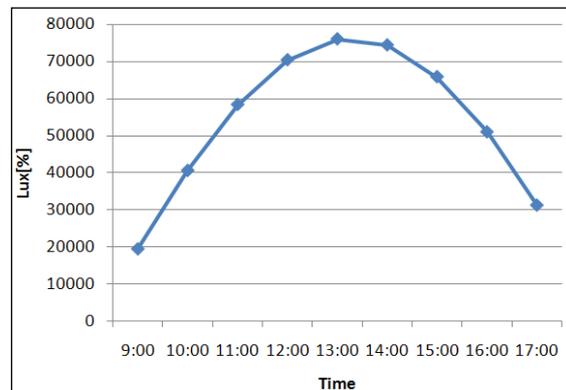


Fig. 1 Outdoor Illuminance

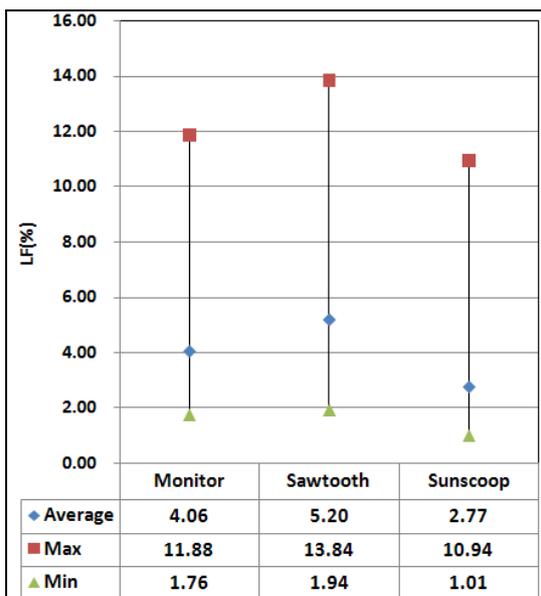


Fig.2 Average, maximum and minimum for the light factor(at 09:00)

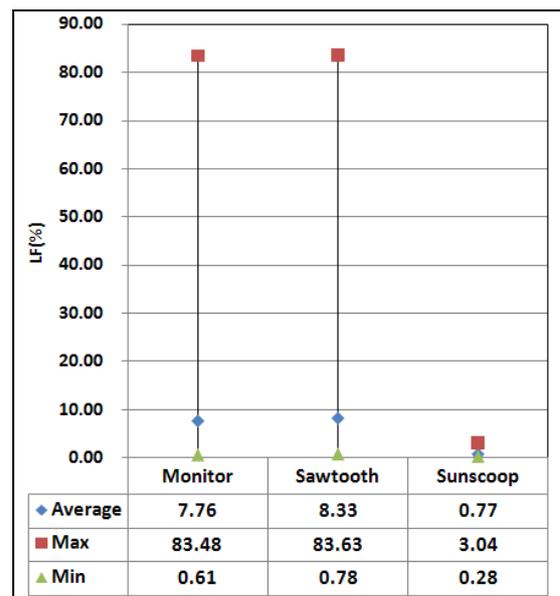


Fig.3 Average, maximum and minimum for the light factor(at 12:00)

The other hands, the monitor and sawtooth systems produced higher light factor levels that the main reason for the higher illuminance values with the monitor and sawtooth systems is the fact that the direct sun. The maximum light factor at 09:00 am was 11.88% with monitor, 13.84% with sawtooth and 10.94% with sunscoop. Also, the maximum light factor at 12:00 pm was 83.48% with monitor, 83.63% with sawtooth and 3.04% with sunscoop.

A high light factor for monitor and sawtooth systems may be caused by a disturbing bright sunpatch on a surface. The sunscoop produced a lower light factor than the monitor and sawtooth systems. The minimum light factor at 09:00 am was 1.76% with monitor, 1.94% with sawtooth and 1.01% with sunscoop. Also, the minimum light factor at 12:00 pm was 0.61% with monitor, 0.78% with sawtooth and 0.28% with sunscoop.

4. CONCLUSION

This study simulated the effects of three topside lighting systems on daylighting performance. The light factors were often significantly 2~10 times higher with the monitor and sawtooth system than with the sunscoop system. The sawtooth window system has shown the most efficient daylighting performance under clear sky. The sawtooth system with south-facing openings allows a better quality of illuminance.

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