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A Preliminary Study on the Lighting Performance Evaluation of Light-Shelf Applied with Perforated Reflector According to Changes in the Width of Light-Shelf during Summer Solstice

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Abstract. Due to increased indoor lighting energy consumption, various studies for reducing its consumption are being carried out. Among various methods, the light-shelf can bring natural light into indoors, reducing the consumption of lighting energy during daytime. Its efficiency has been recognized so that it has been applied and used in various studies and fields. The performance of external light-shelf has been recognized, but it is limited for applying to high-rise buildings where are affected by wind pressure. In this study, the external light-shelf applied with the perforated reflector which can be applied to high-rise buildings is suggested.

Keyword: light shelf, Punched reflector, Vent ration, performance evaluation

1 Introduction

1.1 Background and purpose of study

The performance of light-shelf has been recognized as one of solutions for energy issue at the time which requires technical developments and studies regarding energy-related issues, and various studies regarding the light-shelf are being carried out. Especially, the external light-shelf has excellent lighting performance so that it has been applied frequently, but in case of high-rise buildings, there is a concern of damage due to wind pressure so that various studies regarding the light-shelf with no it has been applied to low-rise buildings mainly until now. However, the previous studies were carried out with fixed width of light-shelf so that the improvement of performance was limited. Therefore, the purpose of this study is to establish preliminary data of light-shelf applied with perforated reflector through the

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performance evaluation according to changes in the width of light-shelf applied with perforated reflector.

1.2 Method of study

This study is carried out in the following order. First, the concept of light-shelf and the literature regarding the perforated reflector are reviewed. Second, the variables of light-shelf are set for carrying out the performance evaluation. Third, the lighting performance between the previous light-shelf and light-shelf applied with perforated reflector is compared and analyzed. Lastly, the conclusion is drawn through the comparison and analysis data.

2 Perforated reflector applicable light shelf

2.1 Concept of Light shelf

As shown in <Figure 1>, the light-shelf is the national lighting system which blocks direct natural light from outside, brings natural light into indoors through the reflection to distribute indoor illumination evenly, improve the quality of indoor space and reduce the consumption of lighting energy.[1]

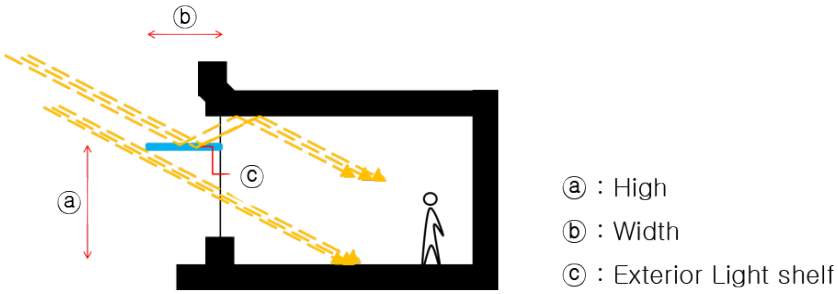

Fig. 1. Concept of Light shelf

2.2 Concept of punched reflector

The perforated reflector is a flat reflector with holes in various shapes, and the concept of punching metal is applied. The punching metal has been used widely in spaces with various designs and patterns [4]. Generally, the size of circular hole is 4(29.55%), 6(32.58%), 8(34.27%) and 10(40.22%). In this study, the shape of hole is limited to normal circular shape.

3 Perforated reflector applicable ore mill performance evaluation

3.1 Setting the external environments and light shelf factors for performance evaluation

The variables of light-shelf set in this study are shown in <Table 1> which are set based on the preceding studies. [1] The general specification of perforated reflector in the punching metal company is used. [5].

Table 1. Variables of light shelving systems

Light shelf	width	400mm, 500mm, 600mm
	height	1800mm
	reflectance	Reflective film (Reflectivity 85%)
	angle	Fixed-type (0°)
	Vent rate	29.5%
Meridian transit altitude		Summer Solstice : 76.5 ˚

3.2 Overview of test bed for indoor environments

The test bed used in this study is designed as 6.6 m for depth, 2.5 m for the height of ceiling and 4.9 m for width.[1]

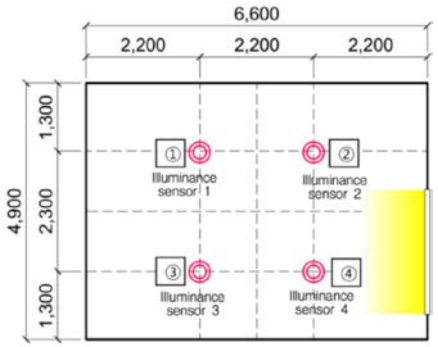

Fig. 2. Section of the test-bed

3.3 Performance evaluation of Illumination sensor positioning

The illumination sensors for evaluating the lighting performance of light-shelf applied with the perforated reflector according to the width of light-shelf are installed on 4 divided spaces of test bed.

3.4 Result of lighting performance evaluation according to the width of light-shelf applied with the perforated reflector

The result of lighting performance evaluation according to the width of light-shelf applied with the perforated reflector is as shown in <Table 2>, and it is confirmed that the performance is improved as the width increases.

Table 2. Perforated rate 4, Light shelf performance evaluation based on the light shelf with vent or without Vent

	Perforated not applied (lx)											
Width	400mm				500mm				600mm			
Sensor	S1	S2	S3	S4	S1	S2	S3	S4	S1	S2	S3	S4
	46.25	102.50	26.25	290.00	46.50	60.00	25.00	239.00	64.12	65.42	31.19	293.00
	Perforated applied (lx)											
Width	400mm				500mm				600mm			
Sensor	S1	S2	S3	S4	S1	S2	S3	S4	S1	S2	S3	S4
	50.00	103.75	25.00	290.00	55.00	73.50	53.75	271.25	53.75	70.00	33.75	250.00

4 Conclusion

The purpose of this study is to prevent the external light shelf and verify its effectiveness through the performance evaluation in order to solve its limit in applying to high-rise buildings due to wind pressure. The lighting performance of light-shelf applied with the perforated reflector can be improved by increasing the width of light-shelf so that in order to maintain the light-shelf with no perforated reflector, it is necessary to increase its width. However, it is meaningful since it can respond to the external wind pressure, and there is a possibility that the lighting performance can be improved by applying the angle of light-shelf which is not considered in this study. Therefore, the performance evaluation with variables including the angle of light-shelf and the perforation rate will be necessary in future.

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