ABSTRACT

Developing a Numerical Model for the Geometrical Configurations and Optical Behaviors of Fluorescent Luminaires

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Recently, Task and Ambient Lighting(TAL) gained its popularity as a lighting system in many office buildings in which the workstations are usually divided by interior partitions. The luminaires are equipped with various kinds of reflectors and louvers in order to reduce glare. The interior partitions and luminaires with louvers make it difficult to accurately predict illuminance distributions by the conventional point-by-point method and split flux method.

The purpose of this study was to develop a numerical model which can accurately estimate the illuminances by fluorescent luminaires with various reflectors and louvers for the modern office environment. The numerical model was developed based upon the Monte Carlo method and ray-tracing technique. Then, the accuracy of the numerical model was validated through measurements.

This thesis consists of a total of five chapters, and each chapter can be summarized as follows:

In Chapter 1, the background, the objective, the scope and the method of the study are described.

In Chapter 2, theories related to the modeling of the geometrical configurations and optical behaviors of fluorescent luminaires are reviewed. The theories include Monte Carlo method and ray-tracing technique.

In Chapter 3, modeling algorithms, flowchart and modules of the numerical model are

described.

In Chapter 4, The accuracy of the computer model is validated through measurements inside a real room and a physical scale model.

In Chapter 5, the conclusions of the study are stated.

The results can be summarized as follows :

[1] In this study, a numerical model for the geometrical configurations and optical behaviors of fluorescent lamp fixtures were developed. The numerical model could determine illuminance distributions by fluorescent lamp fixtures installed at a random location and to a random direction. In addition, the developed model was able to calculate interior illuminance distributions without the candela distribution data of lamps.

[2] The number of photons generated was a major factor which determined the accuracy of the numerical model. From the validation process it was revealed that 10,000 photons per lamp resulted in acceptable accuracy.

[3] The average relative error of the numerical model was less than 10%. Therefore, it can be considered that the developed numerical model can be applied to the estimation of illuminances in office buildings with interior partitions and fluorescent lamp fixtures equipped with various kinds of reflectors and louvers.