Investigate the lighting environment in nursing home from Kruithof curve

perspective: the case of Taiwan

Chinmei CHOU (Yuan Ze University, Taiwan),

Ruyu HUANG (Yuan Ze University, Taiwan)

1. Introduction

Elderly need higher illumination levels than young people because of the visual impairment by aging. With the same task for different ages, Turner et al. (2010) found that a 65 year old elderly need 3.84 times the illumination of a 10 year old. The mood can be changed by different type of lighting environment. Kruithof (1941) found the pleasing curve with different combination of illumination and color temperature. It will be not pleasing when people are in the lighting environment, which is at high color temperature and low illumination, low color temperature and high illumination.

The aim of this study was to investigate the lighting environment in nursing home, Taiwan. With this results to know whether the lighting condition in nursing home are satisfied by elderly in Taiwan.

2. Methods

2.1 Subjects

Field investigation was in northern, central and southern Taiwan, total six nursing homes. These included one nursing home at Taoyuan (northern Taiwan); one at Taichung (central Taiwan); four at Kaohsiung and Pingtung (southern Taiwan). The date of measurements was during December, 2013 to April, 2014.

2.2 Investigative procedures

The investigative procedure was divided by three parts:

(1) Record the environment in nursing home to know the basic design of the building, including windows, the position of lights and doors.

(2) Classify the measure area. In this study, the different space in nursing home were classified into three parts: common room, corridor and activity area. The activity area include living room and dining room because there were different layout for nursing homes

in Taiwan.

(3) Measure the lighting environment. In this study the indoor environment was assessed, including illumination and color temperature. The measure tools were Digital Illuminance Meter (IM-2D, TOPCON TECHNOHOUSE Corp.) and color temperature meter (GL-1, OKTEK Corp.). The measure method was nine point measure method.

2.3 Statistics

We used one-way analysis of variance (ANOVA) to analysis the collected data and the significant level was 0.05 (α). The variable of analysis were showed below:

(1) The independent variable was area of different nursing homes, and the dependent variable was lighting environment (illumination and color temperature).

(2) The independent variable was the area (northern, central and southern Taiwan) and the dependent variable was lighting environment (illumination and color temperature).

Sinoo, van Hoof and Kort (2011) plotted the collected data in Kruithof curve to know the ambiance in nursing home. We used the way to know the ambiance or atmosphere in nursing home, Taiwan.

3. Results

3.1 lighting environment in nursing home

For illumination in common rooms, there were significant difference among nursing homes (p -value < 0.001). It showed the same results (significant difference) in corridors (p -value < 0.001) and activity areas (p -value < 0.001).

For color temperature in common rooms, corridors and activity areas. There were significant difference between nursing homes (p -value < 0.001).

There were also significant difference between areas of Taiwan for illumination (p -value < 0.001) and color temperature (p -value < 0.001). This means that there are no standards or rules for nursing homes in Taiwan.

3.2 Kruithof curve in nursing home

We used the method (Sinoo, van Hoof and Kort, 2011) to plot the collected data in Kruithof curve. The Results showed that the nursing home in northern and central Taiwan, which has a subtropical climate, the lighting conditions were not pleasing according to the Kruithof curve. In collected data, there were more than 90% data at no pleasing area for northern and central Taiwan.

For the nursing home in southern Taiwan, which has a tropical climate, part of lighting condition were pleasing. There were more than 50% data at pleasing area for two nursing homes in southern Taiwan.

One of the nursing homes was lower color temperature (mean = $3717 \pm 408.08\text{K}$) than others (around 5000K). This means the lighting environment for the nursing home was warm, and it might let elderly feel more relax and comfortable.

For the other nursing home, which was more pleasing than others, have half open activity area so that the elderly can have more sunlight. Because of the sunlight, the illumination was higher than other nursing homes so that the data of the nursing home was at pleasing area.

4. Conclusions

(1) There were significant difference between six nursing homes ($p\text{-value} < 0.001$). This means that there are no standards or rules for nursing homes in Taiwan.

(2) In Kruithof curve perspective, the results showed that the nursing home in northern and central Taiwan, which has a subtropical climate, the lighting conditions were not pleasing (90% data was at no pleasing area).

(3) For the nursing home in southern Taiwan, which has a tropical climate, there were more than 50% data at pleasing area for two nursing homes in southern Taiwan.

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Reference

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