INTEGRATION OF FUZZY LOGIC CONTROL ALGORITHM IN THE DEVELOPMENT OF OPTICAL FIBER DAYLIGHTING SYSTEM FOR ENERGY SAVINGS

by

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ABSTRACT

There is normally an excess of daylight outdoors in comparison with what is required at most work places or homes indoors in Malaysia which has a hot and humid climate. This excess of daylight can be harvested, concentrated and distributed indoors by optical fibres to replace or complement the electrical lighting that is currently used today to reduce building electrical demand while improving occupant comfort. Automation in daylighting controls usually employ photosensor-controlled devices, linked to an automated switching or dimming unit that varies electric light power in response to natural light. Optical fibre solar light pipes that are capable of providing the required illuminance during the day are not efficiently utilized. The primary objective of this study is to use solar energy in the form of light to reduce the power consumption required for interior lighting of buildings.

This study was divided into three main parts; The first part was the mathematical modeling, simulation and obtained design specifications of passive daylight collector The second part focused on the illumination performance, the light transmission efficiency and light gathering power of solid core end light optical fibre to determine the best option for the daylighting system. The MATLAB software was used to simulate the optical fibre transmittance for glass and plastic fibres, illumination performance over lengths of plastic solid core end-lit fibre, spectral transmission, light intensity loss through the large diameter solid core optical fibres and the transmission efficiency of the optical fibre. Then the design and construction of the daylight-linked photoelectric switch. The switch used Fuzzy Logic Control Algorithm for automated lighting and dimming control. The performance of the optical fibre daylighting system which included endpiece luminaires was tested using controlled illumination experiments in a scale model of a room. The simulations proved that controllers are able to control the electrical dimmer light and daylight from optical fibre simultaneously. The fuzzy automated lighting and dimming controller was successfully designed and developed. The scale modeling experiments revealed that the passive daylight collector and the larger diameter of 14 mm solid core endlight polymer optical fibres are most suitable for tropical climate. The fibre bundles fitted with end piece luminaires should be used for effective indoor illumination. The

estimation for energy efficient lighting design shows that the daylight from the optical fibre with automated dimming control together with general windows has percentage energy saved of around 67% for the scaled models and cost-effectiveness of the optical fibre daylighting system with Fuzzy Logic automated lighting-dimming control has the potential for a reduction in energy consumption for buildings in Malaysia.

Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and the result of my own work, unless otherwise indicated or acknowledged as referenced work. This topic has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

In the event that my thesis be found to violet the conditions mentioned above, I voluntararily waive the right of conferment of my degree and agree be subjected to the disciplinary rules and regulations of Universiti Teknologi MARA.

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