World Academy of Science, Engineering and Technology
International Journal of Architectural and Environmental Engineering
Vol:15, No:12, 2021

An Approach to Determine Proper Daylighting Design Solution Considering Visual Comfort and Lighting Energy Efficiency in High-Rise Residential Building

Authors : Zehra Aybike Kılıç, Alpin Köknel Yener

Abstract : Daylight is a powerful driver in terms of improving human health, enhancing productivity and creating sustainable solutions by minimizing energy demand. A proper daylighting system allows not only a pleasant and attractive visual and thermal environment, but also reduces lighting energy consumption and heating/cooling energy load with the optimization of aperture size, glazing type and solar control strategy, which are the major design parameters of daylighting system design. Particularly, in high-rise buildings where large openings that allow maximum daylight and view out are preferred, evaluation of daylight performance by considering the major parameters of the building envelope design becomes crucial in terms of ensuring occupants' comfort and improving energy efficiency. Moreover, it is increasingly necessary to examine the daylighting design of high-rise residential buildings, considering the share of residential buildings in the construction sector, the duration of occupation and the changing space requirements. This study aims to identify a proper daylighting design solution considering window area, glazing type and solar control strategy for a high-residential building in terms of visual comfort and lighting energy efficiency. The dynamic simulations are carried out/conducted by DIVA for Rhino version 4.1.0.12. The results are evaluated with Daylight Autonomy (DA) to demonstrate daylight availability in the space and Daylight Glare Probability (DGP) to describe the visual comfort conditions related to glare. Furthermore, it is also analyzed that the lighting energy consumption occurred in each scenario to determine the optimum solution reducing lighting energy consumption by optimizing daylight performance. The results revealed that it is only possible that reduction in lighting energy consumption as well as providing visual comfort conditions in buildings with the proper daylighting design decision regarding glazing type, transparency ratio and solar control device.

Keywords : daylighting , glazing type, lighting energy efficiency, residential building, solar control strategy, visual comfort
Conference Title : ICBEST 2021 : International Conference on Building Envelope Systems and Technologies
Conference Location : Paris, France
Conference Dates : December 30-31, 2021