Abstract

The objective of this study is to develop guidelines for fenestration design of office buildings where solar heat gain and daylight are major concerns in terms of energy efficiency. Computer simulations using Visual DOE 4.0 were performed for office fenestrations equipped with various design features; four orientations; 10-100% window-to-wall-area ratio; 10-100% visible light transmittance of glazing; and 0.2-1.0 shading coefficients of glazing. Daylight sensors were used in the simulation in order to compare the energy saving results with those without daylight sensors.

The simulated annual energy consumptions (in $kWh/m^2.Yr$) indicate that east windows provide the highest energy saving (30.72-31.88%) if daylight is utilized. Consecutively, the north (29.41-31.64%), south (28.11-31.46%), and west orientations (28.52-31.66%) perform less efficiently. In addition, the north and south fenestrations perform the best when the window-to-wall-area ratio (WWR) 40% and glass shading coefficients (SC) are as low as 0.20. East windows with low WWR provide the maximum energy saving once the glass shading coefficients are reduced to 0.2 for all cases, perform the best when the window-to-wall-area ratio (WWR) 40% and glass shading coefficients (SC) are 0.60. For west windows, it was found that there is no significant difference in terms of energy saving found in any cases of west windows and perform the best when the window-to-wall-area ratio (WWR) 10% and glass shading coefficients (SC) are as low as 0.20.

In conclusion, the results obtained from this study are useful for designs of fenestrations in office buildings regarding energy efficiency. The energy saving approach using natural light to reduce the use of artificial light within 1.5 m distance from windows is also compliant to the guidances in the new Energy Conservation Promotion Act of 2007.