Title: Optimum overhang geometry for high rise office building energy saving in tropical climates

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Abstract:

Intercepting the radiant heat wave using external solar shading before penetrating to the internal environment through the envelope openings is the main criterion to prevent solar heat gains into the building. In hot and humid climates, one draw back of using the external shading device is the risk of reducing daylight level in the interior space, which in turn increases the use of artificial lighting. Therefore, it is important to understand the magnitude of energy consumption for cooling and lighting when shading devices are adapted in order to propose optimum external horizontal shading device strategies as design solutions in hot and humid climates. This study investigates the effect of six different depths of external horizontal shading device on incident solar radiation, transmitted solar heat gains, natural-light penetration, building cooling and energy consumption. The experiment was carried out using a standard, single fenestration perimeter office room in a typical high-rise office building. The investigation is conducted using the eQUEST -3 dynamic energy simulation program supported by the DOE2.2 calculation engine. The results showed that overhang ratios of 1.2, 1.6, 0.6 and 0.8 reduced the incident direct solar radiation more than 80% on the east, west, north and south orientations respectively. The target illuminance of 500lux for internal lighting was obtained for overhang ratios of 1.0, 1.3, 0.2 and 1.0 on respective orientations. Further, findings indicated that deeper natural light penetration can be achieved through the bare window under Malaysian sky conditions compared to the common rule of thumb of 2.5 times the window height on all orientations considered. The findings also revealed that optimum energy savings of 14%, 11 %, 6% and 8% were achieved by optimum overhang ratios of 1.3, 1.2 and 1.0 on the east, west and north, south orientations respectively. This study concludes, considering the trade off between total heat gain and natural-light penetration to optimize the total energy consumption as the best option in designing external solar shading in hot and humid climates.