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Thermal Evaluation of Vertical Greeneries for Building Façade with Different Orientations and Shading Percentages by Design-builder Simulation

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Abstract

Green facades are the innovative forms of vertical greenery systems which are good strategies for urban greenery to improve the micro-climatic conditions of the area. This research study examines the benefits of cooling load by the simulation of the typical building. Design-builder energy plus simulation tool is used to estimate the annual cooling energy of the typical building which consists of three stories with four façade orientations with varying shading percentages to determine the optimum vertical greenery solution while taking shading percentage and façade direction into account. Design-builder software was validated by measuring the 24-hour temperature of the existing indirect vertical garden. The validation study was carried by using a basic linear regression model analysis using Mini tab software. Under five shading percentages (0%, 25%, 50%, 75%, and 100%), the building was designed with four orientations (North, East, South and West). As a consequence, there were twenty possible situations, each with four regions and four orientations. Each scenario's yearly annual cooling load was estimated and compared to a reference condition for a building without plants using the software. For four major orientations with varying different shade percentages, an indirect green façade with *Thunbergia laurifolia* was integrated. Validation results exhibit R² value was 0.976, indicating that the model can express 97.6% of the actual data changes. In terms of economics, the building façade with 25% and 50% greenery coverage with a south orientation and 75% greenery coverage with east orientation are the best vertical greenery solutions. The ideal façade is the one that is completely covered in greenery (100%) and faces east.

Keywords: Design-builder, Indirect green facade, Orientation, Simulation