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Quantifying the effects of building greenery and water retention design on the urban biometeorology

Shih Chen Chen (1), Kuo-Tsang Huang (1), An-Chiang Wang (2), and Shih-Chi Lo (2)

(1) Department of Bioenvironmental Systems Engineering, National Taiwan University, Taipei, Taiwan (huangkt@ntu.edu.tw), (2) Architecture and Building Research Institute, Ministry of the Interior, Taipei, Taiwan

The warming trend for the urban thermal environment in the past few decades resulted from climate change. Promotion of green building can improve the thermal environment around building sites. The object of this research is to quantify the effect of green building design and figure out the influential design factors against ambient temperature mitigation and severity of outdoor overheating. In this study, evaluation models for outdoor ambient temperature reduction and severity of outdoor overheating were established for architectural designers to assess the thermal environment difference between the building with and without the green building design. The Physiological Equivalent Temperature (PET) was adopted for assessing the severity of outdoor overheating. This study adopted computational fluid dynamic (CFD) technique to study the effects on the thermal environment of green building designs and therefore the design of experiment (DOE) method was also employed to increase the efficiency of this study. The building coverage ratio, the average building height, the albedo of the pavement material, and the tree's canopy coverage ratio were identified as the most influential factors against the diurnal temperature mitigation with their contributions being 30.2%, 23.4%, 22.2%, and 18.4%, respectively. On the other hand, the contributions against the severity of outdoor overheating of the average building height and the tree's canopy coverage ratio are 43.8% and 38.6%, respectively. The quantitative models for appraising the green building cases were also established and can be applied to evaluate the potential effect of building cases in perspective of its urban heating alleviation and the pedestrian's thermal comfort improvement. The quantitative models for appraising the potential effect of the urban heating alleviation and the pedestrian's thermal comfort improvement of the green building cases were also established. By this means, the established model can be served as a quick assess tool and as a feedback tool for architects, urban designers, or the building management authorities to alter their architectural design schemes, formulate urban heat resilience plans, or help develop low impact development strategies of the building site in achieving a sustainable urban environment.