Computational Investigation for The Windcatcher Top Roof Length Effect on Indoor Air Quality – simulation study

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ABSTRACT:

The main aim of the current research is to calculate the optimum top roof length of windcatcher for enhancing indoor air quality (IAQ) parameters such as (AAV) average air velocity, (AFR) air flow rate, (ACR)air change rate, (MAA) mean age of air and (ACE) air change effectiveness. This work assesses the effect of the top roof length of windcatcher on indoor natural ventilation in a tropical climate or dense urban areas. The research method was conducted through Autodesk CFD 2019 software for simulation purposes. The reference tested model is composed of a rectangular cuboid with 8 m length, 6 m width and 3 m height which represents a small model room for applying the numerical simulation and the windcatcher was combined with the room roof. The tested windcatcher form is a rectangular cuboid of 1.4 m length, 1 m width and 1.5 m height, while the inlet and outlet openings of the wind catcher are 1 m by 1 m. The windcatcher simulation is aimed to determine the IAQ parameters for different 11 case studies with different top roof projection length ranges from 0 cm to 100 cm with an interval each 10 cm.

The main results of these CFD simulations are representing the effect of the projection length of top roof of windcatcher on the parameters of natural ventilation performance. Based on the simulation, it can be concluded that the increasing of the top roof of windcatcher to 100 cm leads to increase in the AAV with 10.5%, increase AFR with 190%, increase ACH with 11% at inlet. Also increase AVA with 14%, decrease MAA with 14% and increase ACE with 67% inside the tested model. Depending on the results, this paper suggests a regression equation that can predict the inlet and indoor average air velocity for different projection lengths for the tested model.

KEYWORD

Windcatcher –Natural Ventilation – Indoor Air Quality

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