Mechanical Engineering Master's Defense

CFD Analysis of Wind Potential Across Rooftop Gaps of Tall Buildings

School for Engineering of Matter, Transport and Energy

Gargi Kailkhura

Advisor: Huei Ping Huang

abstract

The present study uses Computational Fluid Dynamics (CFD) modeling to analyze the effects of Wind Power Potential and Turbulence Intensity associated with aerodynamic design of a building, having a nuzzle-like gap at its rooftop. Numerical computations are carried to investigate the dependence of the above mentioned effects due to three major geometric parameters of the building: (i) the building height (ii) the depth of the roof-top gap and (iii) the width of the roof-top gap. The height of building is varied from as high as 24m to as low as 8m. Likewise, the gap depth is varied from 5m to 3m and gap width is varied from 4m to 2m.The aim of this entire research is to optimize the design parameters of the building so as to get an ideal position for mounting a micro-wind turbine at the building rooftop. And these objectives are attained by performing CFD modeling in ANSYS Fluent 16.0. Results so obtained from this parametric study are then deployed to compute the position for mounting turbine, by varying the building design parameters. These results are clearly shown by obtaining Contour Plots of Velocity and Turbulence Intensity and Line plots of Wind Potential and Turbulence Intensity. Lastly, another set of numerical simulations is performed but in presence of micro-wind turbine mounted at the building rooftop, to further analyze the wind flow pattern across rooftop gaps. All in all, the results obtained by running all the above different cases are carefully examined and interpreted accordingly. Ergo, a detailed analysis is carried to completion so as to learn the nuances of the building design in affecting the wind power potential.

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