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Mitigation of Wind Loads on a Building Using Small Wind Turbines

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Abstract : Extreme wind events, such as hurricanes, have caused significant damage to buildings, resulting in losses worth millions of dollars. The roof of a building is most vulnerable to wind-induced damage due to the high suctions experienced by the roof in extreme wind conditions. Wind turbines fitted to buildings can help generate energy, but to our knowledge, their application to wind load mitigation is not well known. This paper presents results from an experimental study to assess the effect of small wind turbines (developed and patented by the first and second authors) on the wind loads on a low rise building roof. The tests were carried out for an open terrain at the Wall of Wind (WOW) experimental facility at Florida International University (FIU), Miami, Florida, USA, for three cases – bare roof, roof fitted with wind turbines placed closer to the roof edges, and roof with wind turbines placed away from the roof edges. Results clearly indicate that the presence of the wind turbines reduced the mean and peak pressure coefficients (less suction) on the roof when compared to the bare deck case. Furthermore, the peak pressure coefficients were found to be lower (less suction) when the wind turbines were placed closer to the roof, than away from the roof. Flow visualization studies using smoke and gravel clearly showed that the presence of the turbines disrupted the formation of vortices formed by cornering winds, thereby reducing roof suctions and preventing lift off of roof coverings. This study shows that the wind turbines besides generating wind energy, can be used for mitigating wind induced damage to the building roof. Future research must be directed towards understanding the effect of these wind turbines on other roof geometries (e.g. hip/gable) in different terrain conditions.

Keywords : wall of wind, wind loads, wind turbine, building
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