The Utilization of Dimples to Reduce Wind Load on Parabolic Structures

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As urban areas become more densely populated, developers build skyscrapers higher and higher. At higher altitudes, wind speeds increase leaving structures more susceptible to wind flow. By diverting the wind, structural costs decrease and safety increases. With this rationale, the goal of this research project was to design a structure that integrates the usage of vortex generators to promote vortex shedding to divert the wind. This was accomplished by using a computer aided design (CAD) program. Two paraboloids were constructed. The first paraboloid was smooth while the second paraboloid employed the usage of vortex generators in the form of dimples. The paraboloids were then uploaded into Simscale, a CFD simulation software program. It showed that dimples produced vortices with lower magnitudes of velocity. The dimples also redirected areas of high turbulence further away from the experimental structure. From the turbulence simulation, it was shown that dimples created a boundary layer that lasted longer in comparison to the control structure. The model was successful in these aspects of the experiment. The experimental model is better at redirecting the laminar wind flow into turbulent vortices. However, because of the depth of the dimples, higher levels of pressure, drag, and lift were present at the base of the experimental structure. This may be corrected by making the dimples more shallow. New data is continually being found in this study. In the future, with access to a professional wind tunnel, the paraboloids should be 3-D printed and tested for real world results. This structure could possibly be industrially 3-D printed on Mars to help colonize a planet with extreme inclement weather, but should first be tested in a CFD simulator with similar conditions.

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