CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
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Project Number
38115

Project Title
Testing Building Designs with a Wind Tunnel

Abstract

Objectives/Goals
I wondered if you could reduce the damage caused by high winds by using different building designs. This inspired my question, "Which building designs are better for areas that experience high wind phenomena?" I evaluated three sets of variables: shapes, surface treatments, and the use of wind barriers. My hypothesis was that a hemisphere shape with a dimpled surface with a tall wall would be impacted the least by wind.

Methods/Materials
A wind tunnel with Vernier force sensors was built and tested. Next, test objects were created with volume as the common factor for comparison. Initially, I used clay over forms to create objects. Because these cracked, I could not repeat the tests. I used molds and Fix-It All to create a second set of shapes. A test protocol was created to establish the validity of the data. Each object was then placed on the platform in the wind tunnel. Smooth surfaced objects were used for the comparison of shapes. Smooth, rough and dimpled surfaces were used for each shape in the comparison of surface treatments. Finally, each shape with each surface feature was tested using no wall, a short wall and a tall wall.

Results
For the shape study, I compared a cube on its side and its edge, a cylinder, a pyramid on its side and its edge, a cone, and a hemisphere. The pyramid edge, cone, and hemisphere experienced drag that was closer to zero than the cube side, cube edge, cylinder, and pyramid side. In the surface study, the rough surface provided the most improvement for the cube side, the cube edge, the pyramid side, and the cone. For the hemisphere and the cylinder, the different surfaces did not substantially affect the drag on the object. In the barrier study, the short wall reduced drag for every test object. The tall wall appeared to create strong eddy currents. Often, these eddy currents produced wind forces greater than or equal to the force of the wind without a wall but in the opposite direction.

Conclusions/Discussion
The least wind-impacted shapes were the pyramid edge, cone, and hemisphere. The rough surface provided the best improvement for the cube side, cube edge, pyramid side, and cone. For the hemisphere and the cylinder, no surface feature was more favorable. The short wall produced the best wind barrier results. These data proved my hypothesis to be incorrect. This data can be used to help design buildings to lessen the impact of high wind.

Summary Statement
My project was to determine which building shape and building surface experienced the least amount of drag as well as the impact of barriers on the drag.

Help Received
My Dad helped me build the wind tunnel. My mom helped me with editing my report. I would like to thank my teacher, Mr. Blum, for encouraging me.