CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

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Project Number

34408

Project Title

Wind-Proofing Bridges Prone to Hurricane Winds

Abstract

Objectives/Goals

Bridges located in hurricane-prone environments can suffer extensive damage in the forces of a hurricane. The objective of this project was to design a small-scale bridge deck that would limit drag experienced by the bridge deck to a minimum.

Methods/Materials

The experiment employed a home-made wind tunnel that was used for testing. The bridge deck's drags were recorded using springs mounted on the bottom of each bridge. The distance that each spring stretched in testing was recorded, and using Hooke's Law (F=K*X), a principal that was used to compute the drag experienced by each bridge, which is represented by the K variable. The F variable in the formula was the deck's mass, the X variable was the spring stretch length in testing, and the K variable was the computed drag in the formula. Three speeds were used which encompassed 3, 5, and 8 mph of wind. Each one of the four bridge designs was tested in the wind tunnel at each speed 10 times.

Results

Based upon visible observations, the first bridge, the control bridge, performed very poorly throughout all three of the speed tests and did the worst based upon visible observations. The second bridge, a bridge that had curved outriggers, did a little bit better than the first bridge in the speed tests. The third bridge, a bridge that employed curved outriggers and weights on the bottom of the bridge did better than the second and first bridges. Finally, the fourth bridge, a bridge that employed curved outriggers and a deck roof, performed the best out of all the other bridges based upon visible observations.

Conclusions/Discussion

After computing the experienced drags of each bridge deck using Hooke's Law, many conclusions were made. In a constructed overall line graph, encompassing all three speed tests, the second bridge did the worst out of all of the bridges in terms of experienced drag. The fourth bridge did the best out of all the bridges in testing. This happened because the fourth bridge had the least drag, meaning that bridge four was the most streamlined design out of all the bridges and it would perform the best in a hurricane environment out of all the tested bridges. Therefore, the conclusion made was that the more streamlined a bridge deck is, the better the bridge will perform in a hurricane environment.

Summary Statement

Bridges in hurricane-prone environments can suffer extensive damage or can be destroyed in hurricanes and this project is out to solve this problem.

Help Received

Neighbor helped cut materials; Parents helped provide materials; Teacher helped to edit notebook; Mentor helped to provide intellectual knowledge.