CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
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Project Number
J0220

Project Title
The Effects of a Dynamic Load on Structural Integrity

Abstract

Objectives/Goals
Since I live in California where earthquakes are common, I decided to look at earthquake effects on the structural integrity of arches make from materials of different flexibilities. My hypothesis was that arches supporting a significant weight that are too flexible would lose structural integrity too easily. Some flexibility is required since an arch made of material that is too rigid will not be able to absorb significant ground movement. Therefore, a material with moderate flexibility would be most desirable.

Methods/Materials
I designed and had the arches cut made out of different plastics having seven different flexibilities but all the same compression strength. I tested 63 arches, nine replicates for each of seven materials (ABS, Acetal, Acrylic, Fiberglass, Garolite, Polycarbonate, and Nylon 6/6). I fastened each arch to a fixture and #shaker# table that I designed and built. Using a counter I then measured how fast the shaker table was moving and chose three frequencies that the shaker table would go at, 7 hertz, 3 hertz, and 1 hertz. I then steadily poured water into a container hung from each arch while it was on the moving shaker table until the arch either broke or buckled. I then recorded the average weight at which each arch type failed.

Results
The arches composed of the #acetal# material were able to hold the most weight, 3813 grams, which was for times more than the acrylic arches which had the least average weight bearing capacity. The material that was second strongest under these conditions was polycarbonate, which supported on average 2410 grams before breaking.

Conclusions/Discussion
My results supported my hypothesis that a moderate flexibility for the weighted arches was best able to tolerate the #ground# motions.

Summary Statement
This project tests the weight-bearing capacity of different arches in motion on a shaker table I built to simulate earthquake movement.

Help Received
Grandfather let me borrow tools; Connie Chow taught me how to use solid works; Professor at UCSD answered some of my questions; Father bought me the materials.