CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
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Project Number
J1803

Project Title
The Change in Diameters and Its Effect on the Stability of a Dome

Abstract

Objectives/Goals
In my project I started by asking if the diameter of a dome changed, would it affect the stability of that dome. For my testing I used balsa wood and bent it into an arch with a height of ten centimeters. (I tested arches because I did not know a way to built and measure the deflection of a dome and because a dome is an arch rotated on all its axis, I could use the information for domes as well as arches.) I did not have a formula for how much board to cut to have x diameter, so I just measured different board lengths, but if the board length was different and the height remained the same, then the diameter would be different. I tested three 60, 50, and 40cm arches.

Methods/Materials
For my testing I put sack weights on each arch and measured the deflection at each increment of weight. When weight is put on top of an arch or domes the top, where the weight is applied. Sinks down and the sides bulge out, this is called deflection, and this is what I measured to see how stable the dome/arch was. I used the information gathered for three separate tests, the first test being #Weight at which arch broke#, the second test being #Weight of first deflection# and the third test being #Deflection at 1.4 Kg#. I found that overall the arch with the board length of 50cm performed the best, so I concluded that there must be a ratio between the perimeter and height of the arch. The materials I used was balsa wood, an exacto knife, hot glue, and sack weights.

Results
I then continued to find that ratio. To do that I tested a 70cm arch with the same height just to make sure that the 50cm arch was the most stable for a 10cm height; and it was. I then used that ratio of 1:5 for height to perimeter and applied it to others arches with different board lengths. Once I had the arches with the applied ratio I had to prove that that ratio was the correct ratio so I tested the arches with the applied ratio, and arches with the same board length but a different height as the original, and arches with the same height but different board lengths. I then did the same tests as the original arches. Out of the nine extra tests only in two tests the arch with the applied ratio not perform the best.

Conclusions/Discussion
I conclude that the ratio of height to perimeter for the strongest dome/arch possible is 1:5.

Summary Statement
My project is about finding a way to built the most stable dome possible.

Help Received
My math teacher, who is a former civil engineer, helped me brainstorm on ho to built my test.