CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY

Name(s)

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Project Number

22722

Project Title

Truss Analysis: A Study in Engineering Practices

Abstract

Objectives/Goals

"Can you combine member strength analysis and static analysis to form a predictive model for craft stick truss bridge failure?" My project applies engineering practices to a craft stick truss bridge by examining materials and loads. My predictions are based on data I collect through my own member tension, compression, and buckling tests and which then is combined with my static analysis of a particular truss. Then I will build the truss and apply a mid-span point load until the truss fails. My Variable: Truss Type, will have three study values to be sure that my predictive model works with more than one truss type and I will build three of each type.

Methods/Materials

My trusses were constructed out of craft sticks, wire pins, and joint plates. I prototyped the joint plates, to asuure stability, without providing structural support. Using my tension, compression, and buckling fixtures, I tested the craft stick member's strengths, for both long and short sticks. Combining the data collected from these member tests with the static analysis of each truss type, I made predictions on the failures of the three trusses. I set Variable: Truss Type, with three study values: #1: Warren Through-Truss; #2: Howe Through-Truss; #3: Pratt Through-Truss. Building and testing conditions for all trusses were the same. On each truss, I applied a mid-span point load using a bucket of weights. When the truss failed, the weight was recorded with the member name where the truss failed. I compared the actual failure weight and member location with my predictions.

Results

The Howe Truss was the most accurate prediction, breaking within 2 lbs. of my prediction. The Pratt Truss also had good results. I estimated a small range (71.7 lbs +/- 6.3 lbs) of failure. The prediction was 104% of the average. The Warren Truss prediction was incorrect. I attribute this to using only the compression test. Since I performed a buckling test later, the Warren truss prediction would be somewhere between the buckling and compression averages, which would have been correct. In every case, I successfully predicted which member would fail.

Conclusions/Discussion

My hypothesis was correct, combining static analysis and member strength testing, I was able to accurately predict when the truss would fail and which member would fail. The member strength test results for compression and tension were very accurate.

Summary Statement

Combining member strength tests and static analysis, I found that I could make a predictive model of truss bridge failure by testing three truss types.

Help Received

My father taught static analysis, aided with experimentation, & building apparatuses.