Straw Bridge Build

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Abstract

In this class assignment, our group was tasked with building a bridge out of drinking straws and masking tape. The bridge was to span two feet and hold as much weight as possible. Our parameters were to hold as much weight as possible while trying to make a bridge as efficient and as cost effective as possible. We were judged on a credit system, straws were one credit each, an inch of tape was one credit, and labor costs were five credits per team member per hour. We were to first come up with a design, scale it, and come up with a cost estimate for the build. If we ever had to come back for more material, the cost would double, then quadruple and so on. Our plan was to overestimate, and not have to go back for any further material, using a design very close to a standard design that previously existed. This project was planned and completed by the following members: Scott Nevin, Rachel Yergensen, Sean Hamilton, Brandon Betts, and Rene Hernandez.

Straw Bridge Build

Our first challenge for this bridge project was agreeing on a design and properly scaling it. We settled on a design very similar to a Warren Truss that would be below the platform of the bridge. The design calls for long pieces for the top and bottom of the bridge, and several vertical and diagonal support struts connecting the two. Our challenge was to span two feet, so we decided to first make the top of the bridge about two inches longer on either side, which the design did not initially call for, because there was no method of mounting the structure to our span, rather the bridge would simply sit on top of either side of the span. When scaling down, we eventually came to the figures of struts being roughly 3 ¼ inches from their original 4 meters. When designing the long, solid pieces for the top and bottom, we decided to slit straws down the middle, then insert them into other straws, increasing the structural integrity of our longest pieces. After this design and the techniques that will be implemented were agreed upon, we came to this price and materials breakdown:

Straws Needed – 135

Inches of Tape – 225

Number of Hours to Complete (5 Team Members) – 4

When summarizing how close the bridge came to the initial design, the results were pleasantly surprising. A main difference was that the initial design included struts in the shape of an “X” in the middle section, while this proved instrumental in simulation, the process to fabricate it from straws proved difficult and unable to bear much weight, instead we simple replaced it with one diagonal strut. The computer design also automatically added several struts between the two sides, going from each joint to the nearest three; this, again was deemed not possible with the materials provided, so single alternating struts were substituted. In the software, there was also no way to really design the struts directly below the platform, so we opted to add diagonal struts alternating with every section, and then construct a platform from surplus straws when the main construction was complete.

When we were finished constructing, there were roughly ten straws left over, and less than a foot of tape, so luckily, we did not go over on out material budget. However, we did take an extra half hour to construct; this was the only resource that we used more of than anticipated. Our bridge looked very similar to the design with the slight differences in structure that had already been planned for. The bridge looked sturdy and only had a slight bend to it, being almost perfectly straight.

Our bridge was tested with weights increasing from 200 grams up to 1 kilogram. At 500 grams, the bridge bowed heavily, but held the weight without failure. The bridge then held one kilo for about half a minute before failing and dropping the weight. The weight of the bridge was 59 grams and it held 1 kilogram, giving us an weight to load ratio of 16.9 and a load cost ratio of 1.96. The point of failure was on the bottom of the bridge on the long pieces spanning the length of the bridge. The joints where the straws were connected end to end, came apart from tension forces, when weight was applied. We then put the pieces back together and strengthened the joints that failed with some extra tape. After this alteration, the bridge now weighed 61 grams and succesfullly held 1200 grams, before failing in a similar fashion. With a weight increase of 3.3% we increased the load capacity of the bridge 20%, giving a new load to weight ratio of 19.67.

Included on the next page are pictures of the original design and final product.