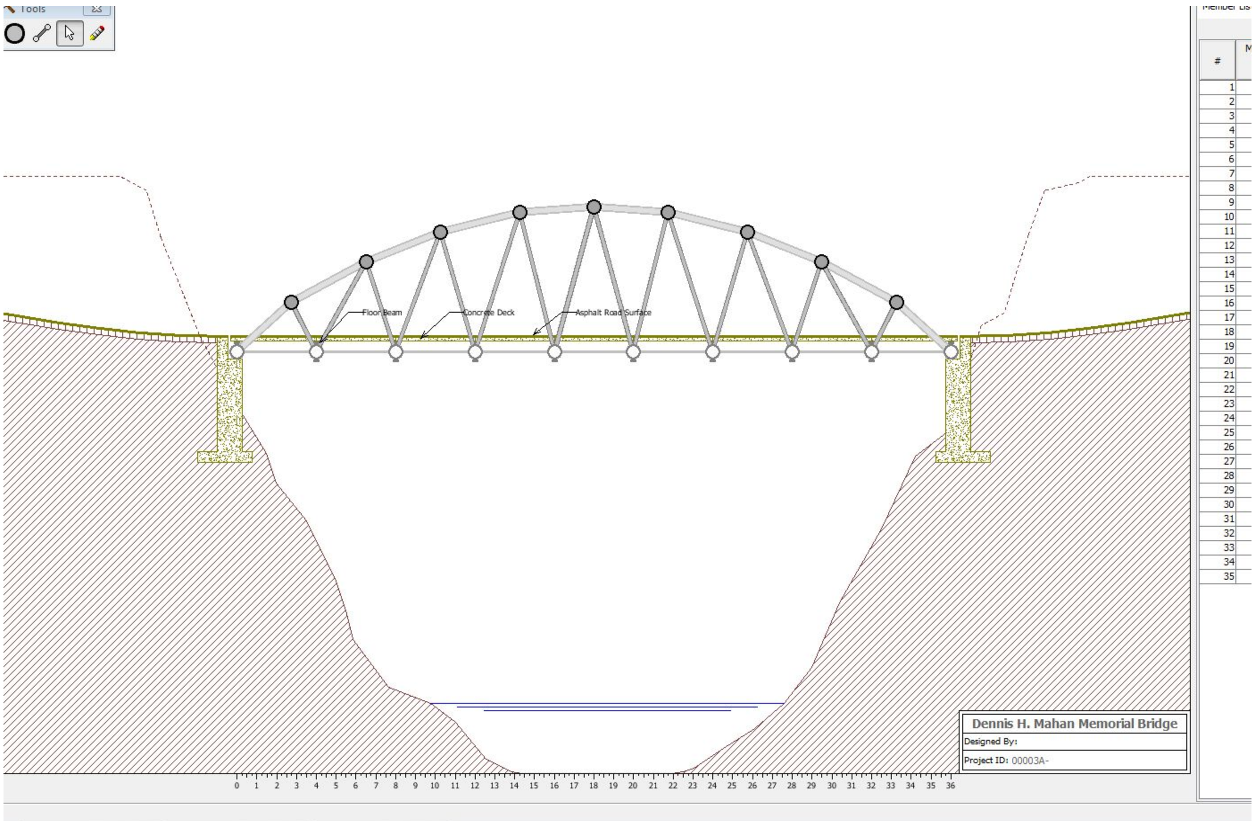

The Popsicle Bridge: Post Design Report

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Mr. Mills

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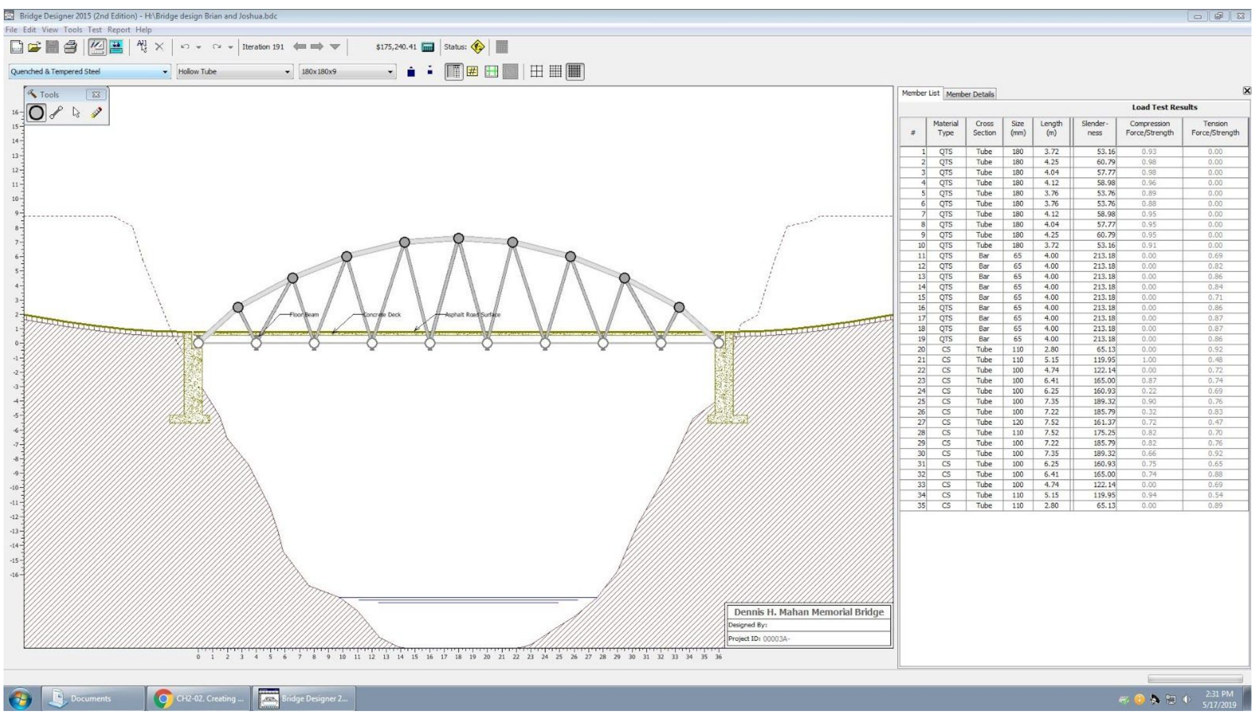
Introduction:

The point of the assignment was to build a bridge over a span of 60 cm in which could hold the most weight among the other bridges in the class. Before building the bridge we were instructed to make an online bridge on CAD Bridge Designer and we were to follow the layout. By doing so we were able to figure out all the members lengths by measuring it with a ruler and multiplying it by our ratio. The material we received were 100 popsicle sticks which we would use to make both the frame and connecting parts of the bridge. The bridge was also to have a deck that was 3.5 inches wide and an opening of about 2 inches was to be left to put the bucket when the time for testing was due.Before building the bridge on the CAD designer we were to choose a style of bridge and we chose the truss system. To be more specific we used the Parker design for our bridge.

Build Process

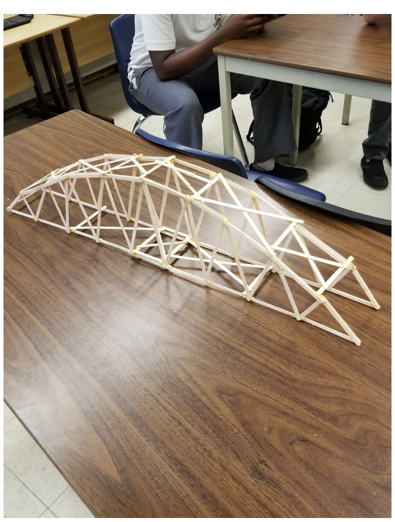
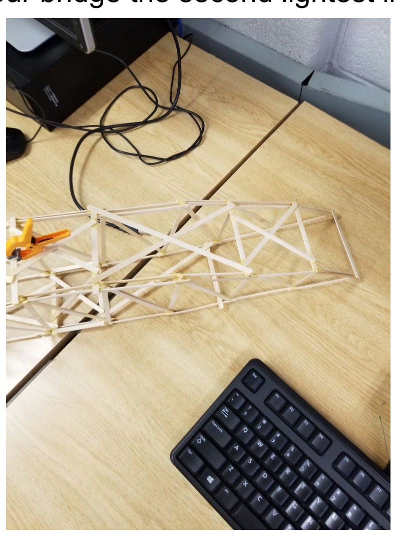
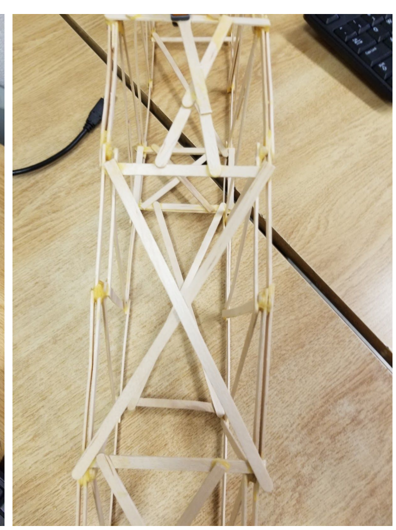


Bridge Designer Process:

To start with the process of our building of the bridge online we had to start by choosing a bridge design to carry out. We chose the Parker design and made a few modifications on the angles of the members on the inside of the bridge. After this we began by implementing all our members making everything out of carbon steel and solid bar. The price remained very high due to the expense of the materials of our members. We then changed some members to quenched and tempered steel, and the others to high stretch alloy. We had all the tube types on hollow, except for on the bottom after we made it solid bar as we were able to minimize the size of it which ended up making it cheaper. We noticed the smaller the bridge was the more force it put on the members but made it cheaper due to the fact that because the size of the member was now smaller it became cheaper. After small modifications we slowly started to cut down the cost of the bridge and this resembled the fact that it would carry out to making a stronger bridge in reality due to its efficiency.

Building Process:

In terms of how we carried out the bridge process was far more different. Now we couldn't take chance by adjusting after as we had to be sure of what we wanted to do before we started to be exact. We started off by measuring the length of each member on our drawings and multiply it by the ratio we got to get a realistic sized fridge. Then after do so we cut the popsicle sticks to the length needed and gathered them together and they were then organized. After having all our pieces we checked the software to see what needed to be doubled based on compression as we thought that was what was most important. After doing so we decided not to double anything on the bottom but specifically double all the members on the top of the bridge. There were specific members in the middle that were very close to max capability so we decided to double layer those as well on our bridge. This ultimately would have a great affect as the weaknesses on the software would really be the same members in reality too. The triangles in the middle of the bridge are part of the truss system and this is what provided a lot of support to the bridge. Aside from the top layers these were ultimately the most important members in the bridge as they were being affected by both the tension and compression of the weight. This is why having to make sure they are aligned is really important that way they work together, or else they become weaker working on their own. We noticed the lower bridges were cheaper on the software but also the taller ones may have been more expensive but were more stable. This is why we decided not to make it to short but also not to tall either. This would help our efficiency but also the stability of our bridge. In the end we decided to make the bottom in the middle more strong by doubling it as this is where the weight would be put therefore making it less pressure, and decreasing the chance of failure on that part of the bridge. You can see that that directly in the image below. The process to making the bridge was a success as we were able to hold 15 pounds having our bridge the second lightest in the class.

Discussion Questions:

1.Did you decide to revise your original design while in the construction phase? Why?

While we were designing our popsicle bridge via the bridge designer application, we decided to utilize the Parker Truss design. Throughout the designing and building process of our bridge there was no need to change our design. The design of the Parker Truss was really effective at supporting the load while not costing a outrageous amount. With the efficiency of the Parker Truss, our group had no necessary reasons to modify our bridges design.

2. How many popsicle sticks did you end up using? Did this number differ from your plan? If so, what changed?

At the start of the building process after we had finalized our design on the computer software, we were given 100 popsicles stick, no more and no less to. Then the construction phase had started, in the beginning we thought that 100 sticks was a overkill and we would use a lot less sticks. Little did we know this was completely false, as our bridge progressed we quickly started to realize that 100 sticks was not enough for us. When the testing day came we ran out of sticks and quickly glued bits of sticks together to form larger one in order to compensate for our depleted popsicles sticks. In conclusion, we didn't have enough sticks and things hadn't gone according to plan and we had to improvise by utilizing our scraps.

3.Do you think that engineers have to adapt their original plans during the construction of systems or products? Why might they?

Yes, I do believe engineers have to adapt to their original plans during the construction of their systems or products because things are constantly improving and evolving. Engineers probably do it all the time especially during the building part of their design, along the way engineers will realize ways to improve their invention and make it more efficient. It is sort of like trial and error, usually the first couple drafts will fail and the flaws will be discovered and fixed. For example, when we designed our bridge with Bridge Designer 2015, there was constantly switches between various materials and member sizes. This method ensures our system improved slowly over time until it reached its maximum potential. During the design process engineers will encounter many obstacles and quick thinking is need to overcome them, so in summary engineers are always trying to change their design in order to compete with others and improve their product. This is why in the 21st century there has been drastic changes in our technology.

4.If you had to do it all over again, how would your planned design change? Why?

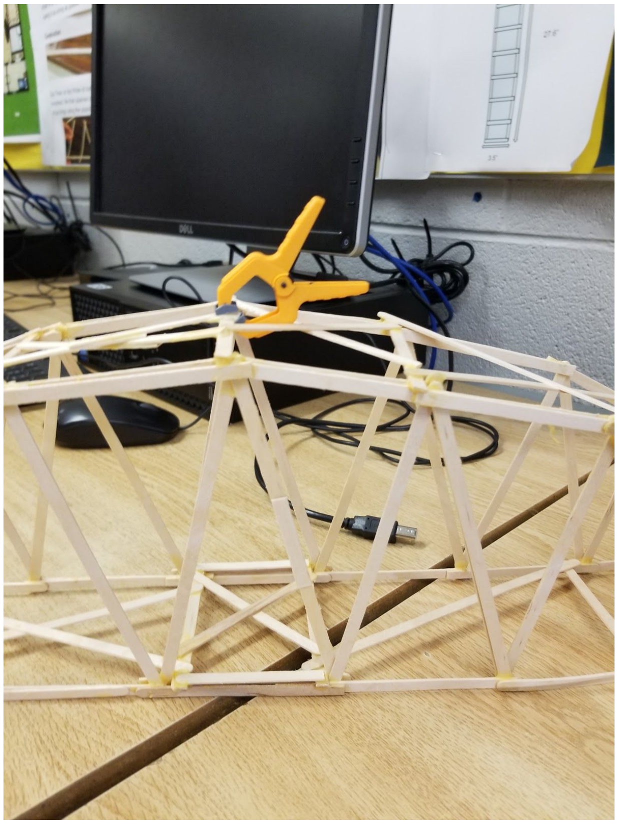
If we had a second opportunity to design and rebuild our bridge we would have tried to work more efficiently since we ran out of times towards the end. Our group had decided on a solid bridge design so our choice of the Parker Truss wouldn't have changed, with a combination of strength and cost efficiency this was our best choice. What would have changed was the usage of glue and craftsmanship. We believe that we used too much glue and that had affected our weight, even though the weight of our bridge was the second lowest of the entire class it could have been lower if we hadn't dunked the entire stick in the glue. Secondly, the placement of our popsicle sticks wasn't great. From our pictures you can see some are sticking out more than others and they aren't even. Fixing this issue could have improved our bridge a little more. Lastly, realized our crucial mistake was throwing out our popsicle stick scraps in the garbage, those little bits could have been used to strengthen crucial members or create larger ones. During the testing date of the bridges, we had to improvise by stalling to go last in order to glue members and rushed to quickly complete our bridge. Without a completed bridge we began the test hoping for result that would not put us in last place. We were shocked to find out that our bridge placed in the top half of the class. All we wanted was to hold 5 pounds, but it managed to hold 15 pounds with a very low weight. With a second chance, we would focus on utilizing the amount of popsicle sticks received and finish the construction before the testing date.

5.What designs or methods did you see other teams try that you thought worked well?

There wasn't much design diversity amongst the class, majority of the class seemed to use the Parker Truss design to build their bridge. Resulting in most Parker Truss' being successful when the loads were placed in the bucket. However one group surprised me by using a completely unique design and placed top three in the class. Stefano and Jimmy's bridge placed high in the class because their bridge was engineered sophisticatedly and had excellent craftsmanship. Both sides of their bridge looked identical and had no visible flaws. We give credit to this amazing bridge and hope to utilize some of their methods such as applying minimum amount of glue and making sure the popsicle sticks are placed evenly.

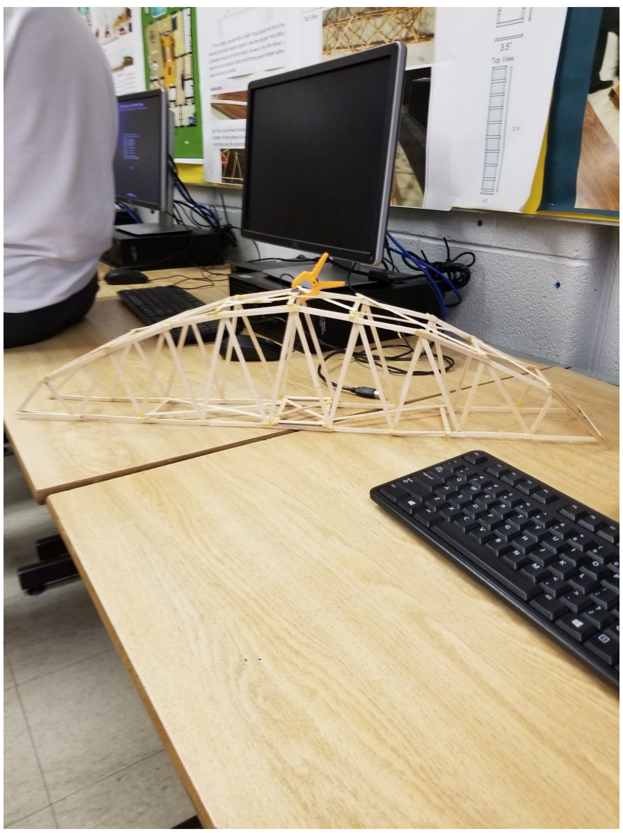
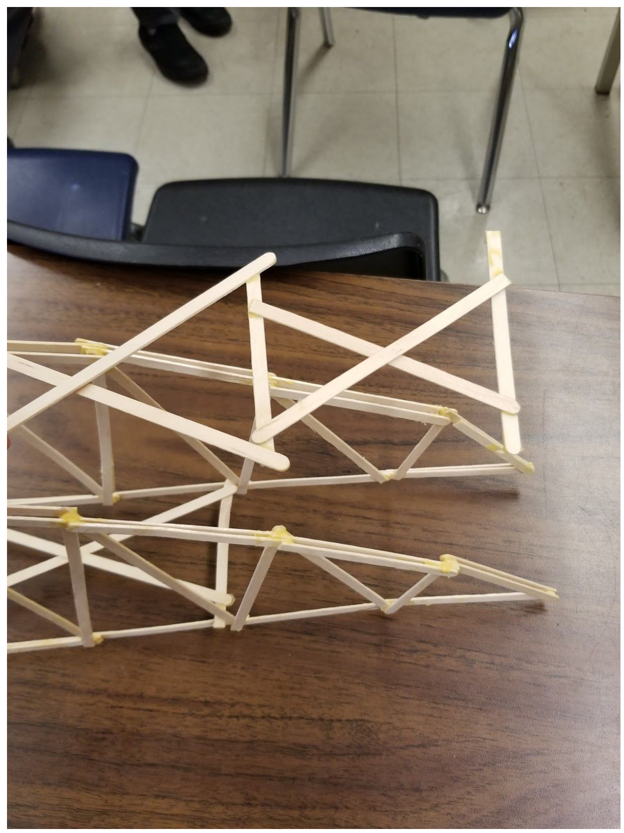
6.What sort of trade-offs do you think engineers make between functionality, safety, and aesthetics when building a real bridge?

When engineers are designing or creating their systems or structures, they oftentimes have to consider between functionality, safety, and aesthetics trying to figure a perfect balance between these categories. In our personal opinion, a good engineer always prioritizes safety and functionality over aesthetics. Even if your bridge is the most eye catching but fails to supports its load makes the bridge entirely useless. Engineers will prioritize safety, then functionality and lastly aesthetics. The main goal of a bridge is to safely allow pedestrians to cross two specified points without it collapsing under the forces acting against it.. Any engineer who prioritizes aesthetics over safety can't be trusted to design a fully functioning bridge because they might jeopardize someone's life just to make the bridge seem appealing. In some cases aesthetics and safety can coexist, an example would be the Golden Gate Bridge. It is San Francisco's main tourist attraction and is visually stunning to look at but is extremely functional and safe.



Conclusion:

After all the hard work we have put into our popsicle bridge for the past one and a half weeks, from the glueing to the clamping, and the hours that went into making sure every member was working at full efficiency, just to see it in action for a minute before it succumbed to the compression forces that the weights had applied to it. It was all worth it though it the end since it rewarded us with placing top half of the class and with the experience of designing our own self made bridge. We think the building process of the bridge was the most enjoyable because it challenged out engineering skills to the max to compete with other groups to see who could design the more efficient bridge. Our group truly bonded over this experiencing and tested our teamwork skills, there were some things we didn't agree upon but in the end we met in the middle and came with an agreement. This project was more than a school assignment, it felt really chill and relaxed and didn't put a lot of pressure on us. Everyday we would just sit in class and glue popsicle sticks and have conversations, it seemed like a free period most of the time instead of just class. Lessons we learned along the way was to use our time and resources more wisely. When we first started the building stage and we were given our 100 popsicle sticks to begin with. Our minds were like 100 sticks is an overkill but nearing the completion of our bridge we knew the sticks we had leftover were not adequate. To makeup for our mistake, we took scraps of popsicle sticks and glued them together to create one longer member. Then we ran out of time, while the other. group's bridges were being tested. We were rushing to complete ours by filling gaps with the popsicle we had left. When our bridge was being tested, one popsicle stick at the top was not done drying and came off when the bucket was placed. Our hope was the bridge would hold 2.5 pounds to not come in last place. Surprisingly it held 15 pounds and was extremely light to put us in the top half of the class.

References:

- ➔ Bridge Designer 2015
- ➔ Unit 3 Bridge Design: TDJ3M2-01