· In terms of structure and material, what makes a bridge strong?

· Are some shapes (truss, suspension, beam, cable stay, etc) and/or materials better than others? If so what are the pros and cons of working in different construction methods or different materials?

· Is one type of bonding (gluing), joining methods or patterns, or fastening stronger than another? Explain.

· What are the typical structural components of several different bridge designs?

· What types of beams, cables, fasteners are used?

A vast variety of items can be used in this bridge building project. We were given two types of wood to help build our bridge. Balsa Wood at varying lengths and one hundred Popsicle sticks. Popsicle sticks will be the weight bearer as if they are interweaved in the correct way they can make a very strong support system for weight bearing or trusses. According to the Yale-New Haven Teachers Institute if the Popsicle sticks are arranged in a triangle instead of a square it can hold more force applied. The next wood is balsa wood and it is considered a miracle material. Tim Van Milligan from Peak of Flight states, “It has the best strength-to-weight ratio of any other readily available material. Not only is it known for its high strength and low density, it can be easily shaped, sanded, glued, and painted. “(Milligan 1) So if we need to bend or shave down any wood balsa wood is our go to over the popsicle sticks. We are also being given two types of glue and those are hot glue and wood glue. Hot glue can be used for well for attaching pieces of wood that will not hold a lot of weight. Wood Glue is the better option when it comes to strength because it soaks into the wood to create a very strong bond. However, we did not receive a lot of wood glue compared to the mass quantity of hot glue. Fishing line was also given to us to use. The group was a little stumped on what to do with the string. The

main thing we will use it for is to tie around trusses and apply weight to see what design works the best.

· How do the forces that are applied in tension, compression, or torque effect your design?

Multiple forces will affect the design whether is be tension, compression or torque. Tension will be a big factor in our design; if there is too much tension in certain areas they will be very high chance that those points will break when weight is applied. Tension can also be used to our advantage in the fact that if the right amount of tension is applied with crossectional designs it can increase the strength of the build. We will want to try and eliminate compression as when weight is applied it can cause the bridge to buckle under a certain amount of stress. In our bridge we will want to try to eliminate both tension and compression. The goals since we will not be able to eliminate all compression and tension is to try and spread it out and not have it clustered in one or more areas.

· Does the shape of the final design have any effects on strength? Why?

· What are the purposes of a bridge? (why do people make bridges instead of doing something else? i.e. ferry, cars that can float, etc.)

· What makes for a good bridge? (What are an engineer's goals for constructing bridge? i.e. symmetry, width, cost, etc.)

· Does the shape of the final design have any effects on strength? Why?

- A bridge must be built strong enough to support its own weight (called the *dead load*) as well as the weight of the people and vehicles that travel over it (known as the *live load*). The shape of the final design play a really important part on the strength because how you put the bridge together can provide it with strength or a weakness depends on other factor the designer should put in mind such as material and how the bridge part are organized. For example; how the designer put the deck and support it to hold more weight so as the deck have more support, it will have an effect on the shape.

· What are the purposes of a bridge? (why do people make bridges instead of doing something else? i.e. ferry, cars that can float, etc.)

-Bridges are there to help car, trains etc. move through obstacles like sea or river or any other thing like that. Bridges is a better way to make longer roads shorter and make it easy for us to move from one place to another. Bridges would make it easier for cars or trains to move through obstacles and bridges are permanent and cost less to build them instead of having cars floating through water. It also save the trouble of how teaches people all of that and saves them the cost of having cars floating. It is just a simple way to have transportation be easier. In addition, ships use the water to move from one place to another and it will be a mess having cars, train etc. moving through water with ships being there.

· How bridges are supported?

-Bridges are supported to hold more weight and the more they can hold, the more support they need. Bridges are supported by different material to hold them standing while cars or trains move through them. Since bridges stand in water areas, they need material to hold

them standing such as concrete. Different materials are used to support bridges depends on the area and how long is the bridge. The bridge deck must be supported to hold weight so it must be supported from the top and bottom of the deck. In the same time, the lighter the bridge is the better meaning you want to use lighter material that also strong and can hold weight.

· What makes one bridge stronger that the other?

It is simply the material that the bridge made of. Material such as stones, steel or wood and everyone has different strength than the other. The construction material make one bridge stronger than the other and then the shape of the bridge also would make one stronger than the other because engineers should keep in account for things like wind, earthquake and temperature. These are nature effects that even on the material reaction to them. Also, the bridge if it would be supported means the shape or design would be different meaning, the strength of the bridge would change so how the bridge is supported is another factor to strength.

· Selecting the best shape, design and material would make the bridge hold better and weigh less and that is the challenge on this project. Paying more attention to these factors would help in building the perfect bridge that have less weight and more strength. Also, being able to calculate the strength would help the process of the bridge in proportional to the weight. That would happen by testing the bridge before applying a force into it.

Reference:

http://www.nsta.org/publications/news/story.aspx?id=52173

https://www.teachengineering.org/lessons/view/cub_trusses_lesson01

MITTS, C. R. (2013). VIRTUAL bridge design CHALLENGE. *Technology & Engineering Teacher*, *73*(2), 8-14.

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http://teachersinstitute.yale.edu/curriculum/units/2001/5/01.05.08.x.html

https://www.apogeerockets.com/education/downloads/Newsletter69.pdf

https://science.howstuffworks.com/engineering/civil/bridge2.htm