

# Pasta Towers 101

2018 NC Science Olympiad Coach's Institute

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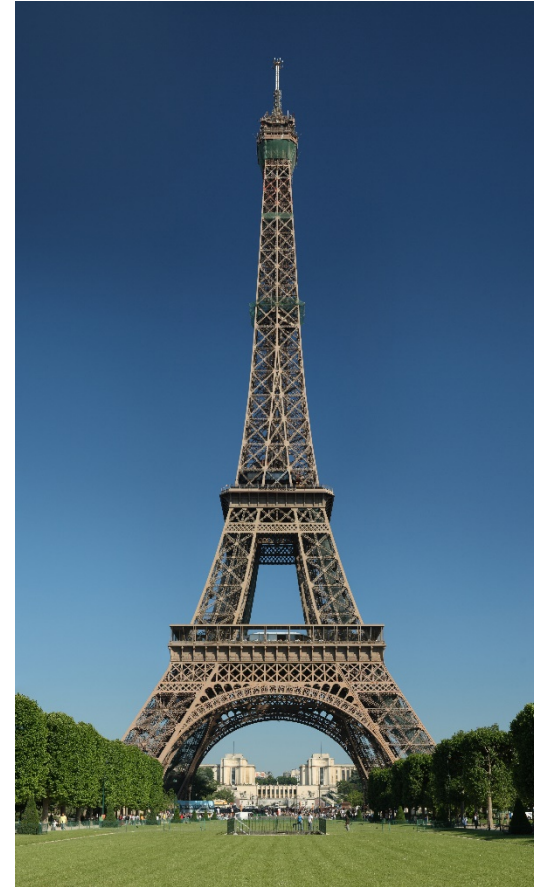
Raleigh, NC

# Introduction

- 15<sup>th</sup> year involved with NCSO
  - 6 years competing
  - 9 years volunteering
- North Carolina State University Alumnus
  - Master's and Bachelor's of Science in Civil Engineering, Structures
- Work as a Structural Analyst
  - Kimley-Horn and Associates
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# What We Will Cover

- 2018 Rules
- Tower Basics
- Construction Tips
- Testing Essentials



# 2018 Rules

- SAFETY is key!
  - Students must wear appropriate eye protection at all times.
  - Recommended for construction and practice as well.
- Towers must be made of Pasta and Glue
  - Any type of pasta can be used
  - Only multi-purpose or hot glue can be used
    - No super glue for ***competition!***
  - You CAN make your own “pasta”

# Dimensional Requirements

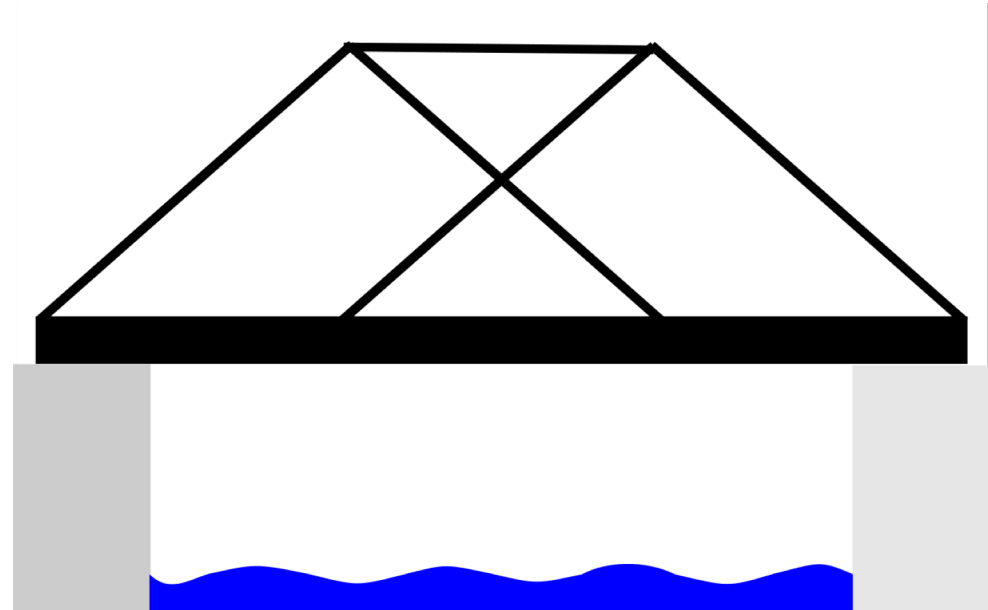
- Towers shall span a 10 cm by 10 cm square opening
  - May not touch in the clear span
  - “Feet” shall bear outside this distance
  - May not go below the support surface
- Towers shall be hold the loading block at least 30 cm above the testing platform
- Towers must be able to be placed on the testing base
  - More on this later
- Towers shall be able to accommodate a 5 cm by 5 cm loading block

# Scoring

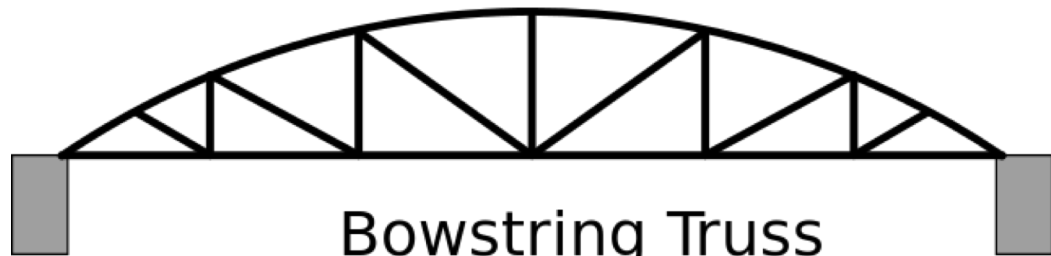
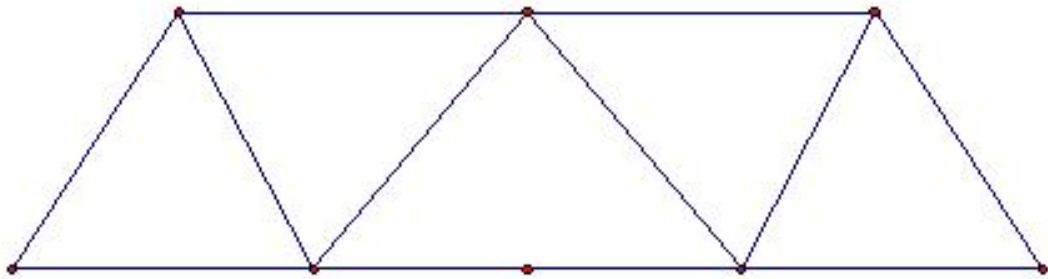
- Towers will be ranked upon EFFICIENCY
  - Efficiency is  $\frac{\textit{Mass Held}}{\textit{Mass of Structure}}$
- Towers/Teams that meet all safety and dimensional requirements will be placed above all others that do not meet them
- The mass judged for a team will not exceed 10 kg (10,000 g)
  - A lighter tower holding maximum mass will place higher

# Tower Basics

- The purpose of a tower is to provide a platform or support a mass at a certain height.
- The most basic type of a tower is a post or a column.
- More complicated towers are trusses.
- Trusses are, generally, **MORE EFFICIENT** than posts.



# Trusses



**Bowstring Truss**  
Top chord is a true arc. Members are often like a Pratt

- Trusses are made up of individual members in compression (pushing) or tension (pulling) and the joints between them.
- There are many types of trusses:
  - Pratt
  - Warren
  - King
- Each type of truss puts forces on their members differently.



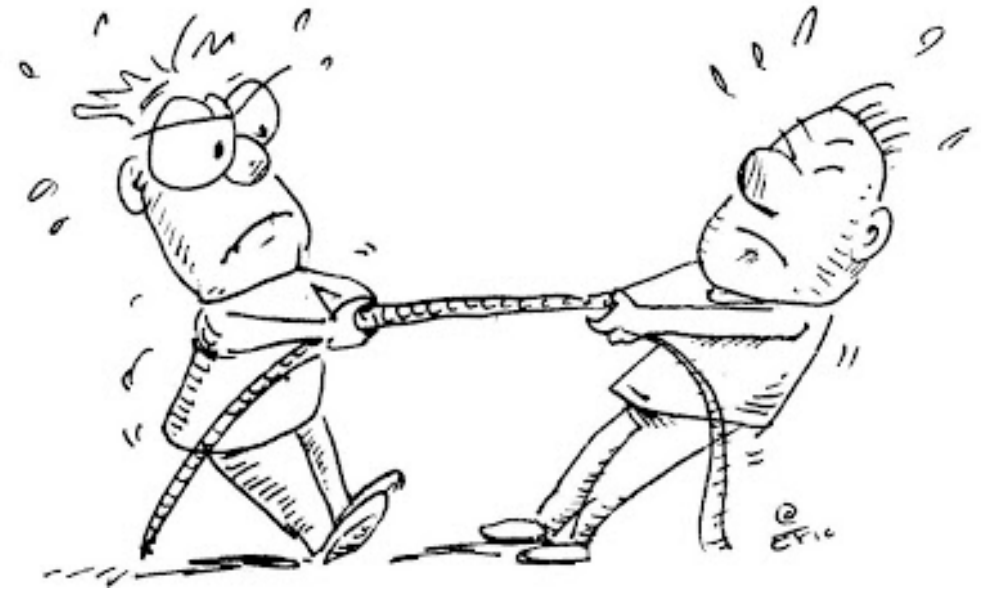
Yes, those were bridges...

...but a tower is a tall, skinny  
bridge!

The lessons for trusses for bridges can be used for towers.

# Tension Members

- Strength of tension members depends on the material and cross-sectional area.
- If a tension member is not strong enough, try a larger member.
- If a tension member is too strong, a smaller member may be more efficient.

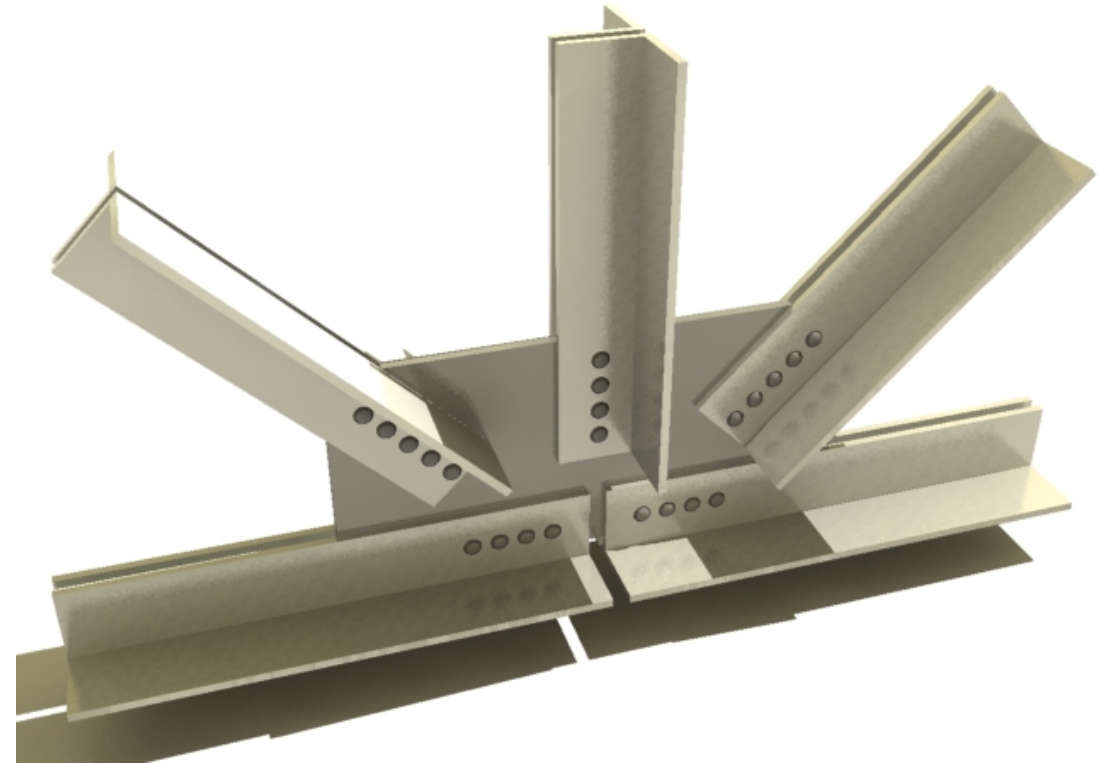


# Compression Members

- Strength of compression members depends on more complicated factors.
- Buckling occurs when a compression member starts to bend.
  - To solve this, try different shapes of pasta and where they are braced along their length.
- Try the yardstick experiment with your students!
- Bracing is key for trussed towers!!!

# Joints

- Joints are the most important part of any structure!
- Like trusses, there are different kind of joints
  - Butt
  - Lap
  - Gusset plates
- TIP: Avoid using butt joints; instead use lap or gussets.



# Construction Tips

- Have students draw out their designs at full scale before constructing.
  - Use straight edges and rulers to get accurate plans.
  - Tape the drawing down on a piece of foam board; you can then use push pins to hold pieces in place on the plans.
- Have your students start small and get larger with experience.
  - Lessons learned on the small scale can lead to success on the large scale!
- Always construct at least two of each design!

# Testing Essentials

- Students must wear eye protection at all times!
- Students will use one of NCSO's "breakers" and testing equipment.
- Students will thread the chain through their structure and hang the bucket underneath.
- The stick on the back controls the flow of the sand.
  - Faster is better for them!



# Lessons Learned

- Keep compression members as short as possible.
  - If unable to do so, brace at regular intervals; it increases capacity.
- Make sure that your student's tower is **TALLER THAN 30 cm!**
  - Every tower needs feet to support it!
- Have your students think about how the tower transfers the force.
  - From the bucket, to the chain, into the loading block, through the structure, and into the supporting surface.
- Leave room for the loading block.
  - It is 5 cm x 5cm in cross-section
  - Ensure your student's tower can receive a loading block.



# Questions?

Feel free to reach out to me with any further questions at:

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