

The background of the entire page is a photograph of the Golden Gate Bridge in San Francisco. The bridge's iconic red-orange towers and suspension cables are visible against a hazy, overcast sky. The bridge spans across a body of water, with a rocky cliff visible in the lower-left corner. The text is overlaid on this image.

THE 25TH ANNUAL POPSICLE STICK BRIDGE COMPETITION 2019

OFFICIAL CONTESTANT HANDBOOK

HOSTED BY

ASCE

AMERICAN SOCIETY OF CIVIL ENGINEERS

Version 1.0

Revised January 10, 2019

25th Annual Popsicle Stick Bridge Competition

Dear Contestant,

Welcome to the 25th Annual Popsicle Stick Bridge Competition (PSBC). For the past twenty five years the Younger Member Forums of the Los Angeles Section of the American Society of Civil Engineers (ASCE), with the help of other engineering organizations and the support of the local engineering community, has been organizing this annual event for high school students.

This event is designed as a fun way for high school students to develop engineering skills through critical thinking, problem solving, teamwork and creativity. It exposes students to the civil engineering profession and introduces them to some of the challenges and triumphs that civil engineers face in their careers. We hope that this competition sparks each student's interest in civil engineering and opens new doors to pursue of math, science and/or engineering-related careers.

This year's competition will be held on the campus of **Cal Poly Pomona (CPP)**. It will take place on **Saturday, March 23, 2019 from 8:00 AM to 5:30 PM**.

Enclosed in this handbook is all the information necessary to form a bridge-building team at your school. Please read through this handbook carefully to make sure that your team follows all the rules and requirements. In addition to this handbook, information about the competition as well as other helpful resources can be found on our website at www.mlab-ymf.org/psbc. Make sure to check our website frequently to stay up-to-date on the latest PSBC news and developments.

On behalf of the PSBC Committee, best of luck to you and your team!

If you have any questions or concerns, please do not hesitate to contact us at popsicle.bridge@gmail.com.

Sincerely,

Your 2019 Popsicle Stick Bridge Chairs:

Ryan Condol, *Metropolitan Los Angeles Younger Member Forum*

Amit Joshi, *Metropolitan Los Angeles Younger Member Forum*



CHALLENGE PROMPT

Dear prospective engineers, we are Bridge Engineers in the State of California. Our organization builds bridges to provide excellent transportation systems for travelling motorists, bicyclists and pedestrians all over the state.

Our mission is: *Provide a Safe, Sustainable, Integrated and Efficient Transportation System to Enhance California's Economy and Livability.*

We hope to inspire in you a passion to become an **Engineer** and help us find solutions for challenges in the world.

Our fellow residents in Los Angeles need your help to make their everyday commute better. As we deal with traffic congestion in LA, a smart alternative is to *Bike to Work*. You as Future Engineers are posed with a challenge to design and construct a Pedestrian Overcrossing Bridge used by bikers and pedestrians. Your task is to develop a LIGHT WEIGHT, STRONG, and FUNCTIONAL bridge that bikers and commuters can use during their daily commute to Downtown Los Angeles.

The challenge for you is to create a working model to demonstrate your ingenuity. Remember, the bridge must be light in weight to minimize its cost, and strong enough to bear the weight of its users. With Popsicle sticks, glue, a strong team, and some good ingenuity we believe you can create a wondrous bridge. Good luck and we look forward to seeing what you have in store.



Florida Gainesville

OVERVIEW

As a participant in this year's Popsicle Stick Bridge Competition, you will be working with a team from your school (*two to four students and one sponsoring teacher on one team*) on the design and construction of a model bridge made solely from common wooden craft sticks and all-purpose white school glue (*refer to the Rules section of this handbook for a full list of requirements*). Your objective is to build the **lightest** bridge that can carry the given maximum load.

The competition is open to all high school students in the Los Angeles Section area, which includes the Counties of Los Angeles, Orange, San Bernardino, Riverside, Ventura, Santa Barbara, San Luis Obispo, Inyo, Mono and Kern. The bridges are to be designed and constructed prior to the competition date, which is scheduled on **Saturday, March 23, 2019**.

Teams will be awarded points based on the performance of their bridge in different categories of the competition *Strength, Efficiency, Workmanship, Presentation and Technical Report* as well as an Impromptu Design event. At the end of the competition, all points will be added and scores of all the competing teams will be compared. A maximum total of **100 points is possible** in this competition. Distributions of points are as follows:

1. **Strength and Efficiency [20 points]:** Top points awarded to the team with the **lightest weight bridge** that can carry **100 lbs.** of load and the most **efficient bridge***. Bridges that cannot carry 100 lbs. will be ranked by the maximum load they can sustain.
2. **Workmanship [10 points]:** Awarded to the team whose bridge appears to the judges to be the most professional-looking and shows a high level of craftsmanship.
3. **Presentation [30 points]:** Awarded to the team that presents their bridge planning, designing and building process in the most creative and professional manner. (Note: 15 points for oral presentation and 15 points for display board.)
4. **Technical Report [25 points]:** Awarded to the team with the best technical report describing the planning, designing and construction phase of their bridge. **
5. **Impromptu Design Competition [15 points]:** Awarded to each team based on their ability to perform a task assigned on the day of the event without any prior knowledge of the materials or the objective.

* Efficiency is calculated as;

$$\text{Efficiency} = \text{Load Sustained} / \text{Weight of bridge}$$

i.e. 100 lbs. / 2.32 lbs. = 43.10 Efficiency

Larger Efficiency number indicates more efficient and better performing bridge design.

Awards will be given to the teams that are ranked *first, second and third* place considering an overall score as well as in the individual categories.

**** Plagiarism of any kind will not be tolerated.** All body of work must be original for this year's competition rules and technical papers **may not be reused or recycled from previous years**. If it is observed that the bridge design idea, concept, technical reports, presentations and display boards of any teams have same or similar information all the teams involved will be **disqualified**. The sponsoring teacher will immediately be notified, and the **disqualified** teams will not be scored and judged during the competition.

REGISTRATION INFORMATION

Please register your school here:

<https://www.mlab-ymf.org/events/popsicle-stick-bridge-competition-team-registration-2>

Registration fee \$5 non-refundable

Registration Open – Starting NOW until March 8, 2019

Late Registration – March 8, 2019 to March 15, 2019

Submittal Information

Questions? Please Feel Free to Reach out!

In order to help facilitate any questions about registration, rules, etc. we have created the following email addresses! Please email your geographic area:

popsicle.bridge-LA@gmail.com

- All LA County High Schools
- All other schools not captured in OC/San Bernardino/Riverside

popsicle.bridge-OC@gmail.com

- All OC County High Schools

popsicle.bridge-SBR@gmail.com

- All San Bernardino / Riverside County High Schools

MISSION

To provide an exciting, challenging, and educational experience to the students while exposing them, through hands-on activities, to the many wonders of civil engineering as a profession.

This will be accomplished by:

- Promoting engineering skills – not only the technical aspects of problem solving, but also emphasizing the importance of teamwork and communication.
- Creating opportunities for interaction among students, teachers, and the engineering community.
- Inspiring students to pursue a career in engineering.

CONTEST STAGES

This contest is created by engineering professionals to replicate the actual experience of designing and building an engineered solution to a problem. The three stages to creating a winning bridge similar to the design of an actual bridge are:

Stage 1 – Design

Stage 2 – Construction

Stage 3 – Presentation

STAGE 1: DESIGN

The first and most basic stage of the competition is the **Design Stage**. This is a stage often neglected by contestants that are eager to get started on the construction of their bridge as soon as possible. This type of approach is not recommended. Instead, plan out your design. Use the science and math skills you have learned in school to come up with some bridge concepts. Pay close attention to the topics of load distribution, tension, compression, and trusses. Your sponsoring teacher will be a very valuable resource at this stage as he/she is your most readily available source of information on the subject. Do some research on different bridge types, visit your local library to find books on the subject, search the Internet for helpful information¹, or talk to engineers for ideas on your bridge concepts.

The Design Stage can be broken further into a few smaller stages: research, design selection, and plan preparation.

Research

Research is the foundation for the entire process. How can you expect to design a winning bridge if you don't understand the basics of how bridges work? Use this stage to become familiar with the many different types of bridges and the types of circumstances in which each type is used. Also, try to figure out which of these types can be most easily reproduced with the materials allowed in this competition. For example, suspension bridges are used to span the largest distances between supports; however, you would be hard pressed to imitate the behavior of a suspension bridge using nothing but wooden craft sticks and all-purpose glue.

¹ For example, check out <http://www.garrettsbridges.com/building/popsicle-sticks/> for tons of useful tips.

Design Selection

Once you feel comfortable with your understanding of bridges, you can enter the design selection phase. In this stage, you will narrow down your options by eliminating the types of bridges which are not suitable for the specific circumstances and desired results of this competition. It is advisable to have each team member explore and do some research on a different approach to the bridge design. Have him/her do the necessary research and then present it to the entire team for selection. If you have enough time to do so, your team may want to experiment with a few designs and carry them into the construction stage before deciding on the final design of your bridge.

Preparing Plans

The final phase of design is plan preparation. What will your bridge look like? How will the craft sticks be arranged? Schematic drawings and plans are valuable tools that engineers use to help them visualize their ideas. Try putting down some of your designs on paper; it will help you see more clearly how your bridge will handle the forces applied. These drawings will also help you during the presentation portion of the competition.

STAGE 2: CONSTRUCTION

While the Design stage challenges your ability to research new ideas and your fundamental understanding of physics concepts, the Construction stage is an exercise in craftsmanship, resourcefulness, and patience. Turning your design sketches into physical models requires good visualization skills and some creative problem solving as you try to tackle some of the often-unforeseen problems that come up during this stage.

- How can we hold the sticks together while the glue dries?
- How can we keep the weight of my bridge to a minimum?
- How do I choose which sticks to use (and not to use)?
- Which sticks should be glued together first?
- How do I make sure that I am gluing the sticks at the proper angles?
- Will the pieces fit together when I am done building them?

These are some of the questions that may come up during construction, and they parallel many of the questions that Civil Engineers face when trying to bring their design off the drawing board and into the real world.

Two structures made of the same materials and following the same set of plans will not necessarily behave the same when subjected to load tests. This is because the quality of construction, and to some extent, the quality of materials, will vary from one to the next. This holds true for your popsicle stick bridge as well; coming up with the strongest design on paper does not guarantee you will have the strongest bridge.

Since you don't have much control over the quality of the wood in your popsicle sticks (however, there are several different manufacturers of craft sticks...), the best thing you can do to regulate the quality of your material is choose sticks with the fewest visible flaws. Moreover, you have complete control over your construction methods, so make sure you give them the

25th Annual Popsicle Stick Bridge Competition

proper attention. Keep in mind that most of the bridges in competition collapse due to **joint failure**, not member failure (i.e. most breaks occur at joints).

We encourage you to allow ample time during this stage to test out different methods and configurations. You may find that the best solutions are often found by trial and error. Feel free to ask your mentors and teachers for advice, but don't be afraid to test out your own ideas. You may find that the best solutions are often found by trial and error.

As you work through this stage, you will see some of the practical applications of the concepts you researched in your design. Explore these concepts thoroughly if you can. We recommend that you build small structures and test their reaction to applied loads using textbooks or other weights and compare their behavior to the predicted results.

Once you begin construction of your competition bridge, carefully review and re-review the contest rules! It would be very unfortunate if you spent all that time and effort designing and building your bridge just to have it **disqualified** due to minor rule violations.

Carefully manage the weight of your bridge and the usage of glue (a total of no more than 50% of each plane side of each stick may be glued to other sticks). For a full description of the rules and requirements, please refer to the "Rules" section of this handbook.

Most important, however, is to not forget to have fun! Every member of your team should have the opportunity to get involved. If a team member contributes an idea that seems like it may not work, don't just shoot it down. Discuss the merits as a team, and have fun testing it out to illustrate the conclusions. Do not just strike down ideas that seem like they will not work, discuss their merits as a team and have a little fun testing them out to illustrate your conclusions. In the words of Brian Wilson, *"Don't be afraid to lose, but be ticked when you do"*.

STAGE 3: PRESENTATION

Contrary to what you may think, one of the most critical skills an engineer can have is to effectively communicate technical material in an understanding and compelling way.

Engineers are often the people best equipped with the knowledge of the technical aspects of a project. Because of this, they are often required to present the aspects of a project to the owner, contractor, regulators, or other stakeholders. The image of the engineer hunched over a computer crunching out numbers all day is outdated. Through the presentation stage we hope to provide an engineering challenge like real world applications while helping students develop their communication and presentation skills.

As part of the presentation of your bridge, you will be expected to write a technical report. Technical writing skills are essential to all engineers and will be used every day in a career of engineering. Whether working to prepare specifications for the proper manufacture of a product, or to organize research data so that others can benefit from your work, or even to create a set of standard procedures and guidelines, engineers must be able to write in a manner that is **clear, concise, and well organized**.

25th Annual Popsicle Stick Bridge Competition

For this competition, you will be creating a case history report documenting the design and construction process of your popsicle stick bridge. In it, you will describe the problems encountered in each stage and the steps taken to solve them. The reports will be judged based on content, structure, and grammar, so pay close attention to all these aspects while writing.

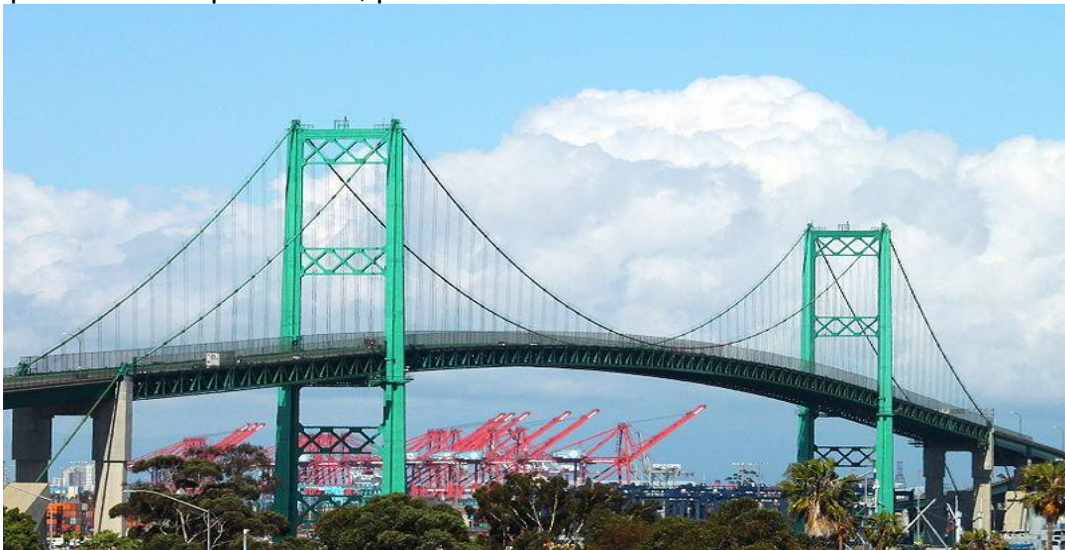
In addition to your written report, you will also be preparing a visual display for your bridge. The display should include plans and/or schematic drawings of your design illustrating how it works. It should also have pictures of the construction process. However, while the written report should be very technical in nature, the display is your opportunity to impress the judges with your artistic creativity. We encourage you to be as creative as you want to be in designing your display; make up a setting for your bridge or even a background story to go with it. The displays will be judged based on creativity and craftsmanship so go ahead and give the right side of your brain a little workout.

Finally, on the day of the event, your team will give a five (5) minute oral presentation summarizing the entire bridge building experience to a panel of judges. The following questions should be addressed during your presentation:

- How was the design of the bridge chosen?
- What construction sequence was used? List step-by-step construction procedure.
- When the bridge is loaded how is the load transferred to the supports/foundations?
- What was the most difficult part of building the bridge?
- What lessons did you learn from the design and construction process?
- How has this project affected your view on engineering?

All members of the team will be expected to participate in the presentation and demonstrate a firm understanding of the design and construction processes. There is no set format for the oral presentations, so you may choose to approach it in any manner you wish, as long as you cover the required points. Please note that no power sources will be provided on the day of the event, so neither your presentation nor your display board should contain elements that require an electric outlet.

For a complete list of requirements, please refer to the “Rules” section of this handbook.



OFFICIAL COMPETITION RULES

Please review the following rules carefully to make sure that your bridge, report, display, and oral presentation comply with all of them. **No exemptions will be given on the day of the event.** If you wish to challenge or discuss any rules, please contact the contest organizers **before Friday, February 22, 2019** (See first page of this handbook for contact information).

General Rules

- Popsicle Bridges, Reports and Displays found in violation of any of the rules stated hereunder will be assigned a penalty as described in the “Rule Violation” Section.
- If there are egregious violations of the rules, the judges reserve the right to disqualify a team, or award zero points in any category.
- **Plagiarism of any kind will not be tolerated.** All teams identified to have similar or same Technical Reports and Displays will be **disqualified** without any discretion.
- All conflicts will be resolved by the Head Judge.
- **The Head Judge’s decisions are final.**

Competition Teams

- Each school may enter up to **four** teams, consisting of two to four students per team.
- All members of a team must be from the same school.
- Students may not be members of more than one team.
- Each team may only submit one bridge for competition.
- Each report must be unique, written and submitted by members of that team. No reports should be same or similar. Plagiarism of any kind will result in immediate disqualification from the entire competition.

Rule Violations: Teams that do not adhere to these rules will be **disqualified** from the competition.

Bridge Materials

- Only white all-purpose glue may be used to hold together all bridge elements.
- All bridge elements must be made of common wooden craft sticks (standard size: $4\frac{1}{2}'' \times \frac{3}{8}'' \times \frac{1}{12}''$).

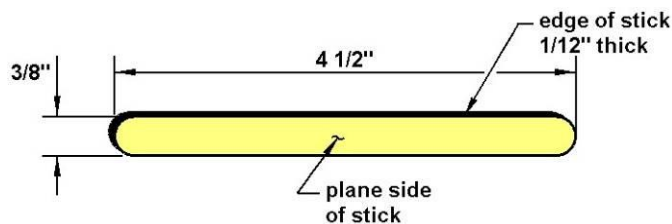


Figure 1 - Common Wooden Craft Stick

Rule Violations: Bridges constructed out of any materials not listed above will be awarded 0 points for the Strength and Efficiency (20) Category.

25th Annual Popsicle Stick Bridge Competition

Bridge Construction

- Bridges must be constructed prior to arrival at the competition; no modifications will be allowed after registration.
- Bridges will be weighed at the start of competition
- No more than 50% of a plane side of a stick may be glued to other sticks (i.e. 50% of each side of all sticks must remain unglued).

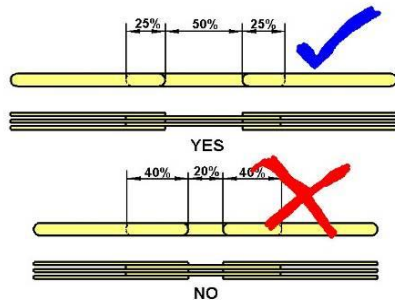


Figure 2 - "50% Rule" Restrictions

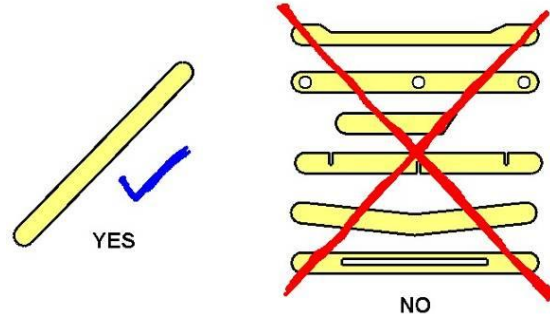


Figure 3 - Stick Alteration Restrictions

- Craft sticks may not be altered or modified in any way, with the following exceptions:
 - Roadway sticks may be cut and/or sanded (but roadway must adhere to all dimension requirements). Roadway sticks are defined as those which will come in contact with the wheels of the toy truck as it crosses over the bridge.
 - Sticks may be sanded slightly to remove waxy film prior to gluing.

Rule Violations: Bridges found in violation of the "50% Rule" will be awarded 0 points for the Strength and Efficiency (20) Category.

Bridge Dimensions

- Bridge length must be a minimum of 48" and a maximum of 56".
- Bridge height shall not exceed 12-inches. Refer to figure 4.
- Bridges shall not be designed to transfer lateral (sideways) load onto the supports.
- Bridge roadway must be continuous, flat, and level. There should be no gaps in between the sticks on the roadway, except for the opening requirement below.
- Bridge roadway must have a minimum 4" width and a minimum 3" height clearance to accommodate traffic (toy truck). Refer to Figure 7.
- Bridges must have a clear 1" x 1" opening along its center from top to bottom. Popsicle sticks can be cut only for this opening. Refer to Figure 6.

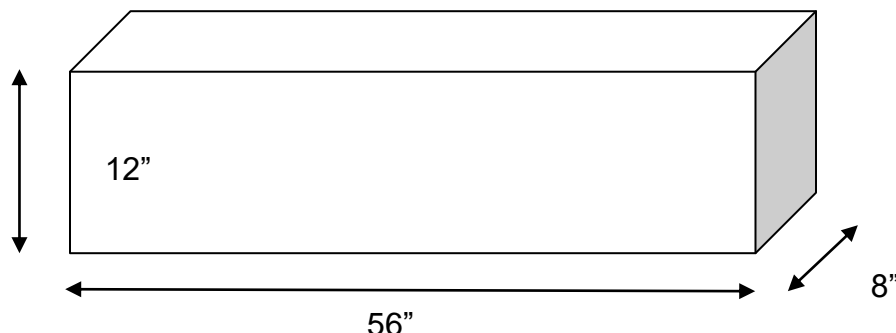


Figure 4 - Dimensions of the box where the bridge must fit in (Not to Scale)

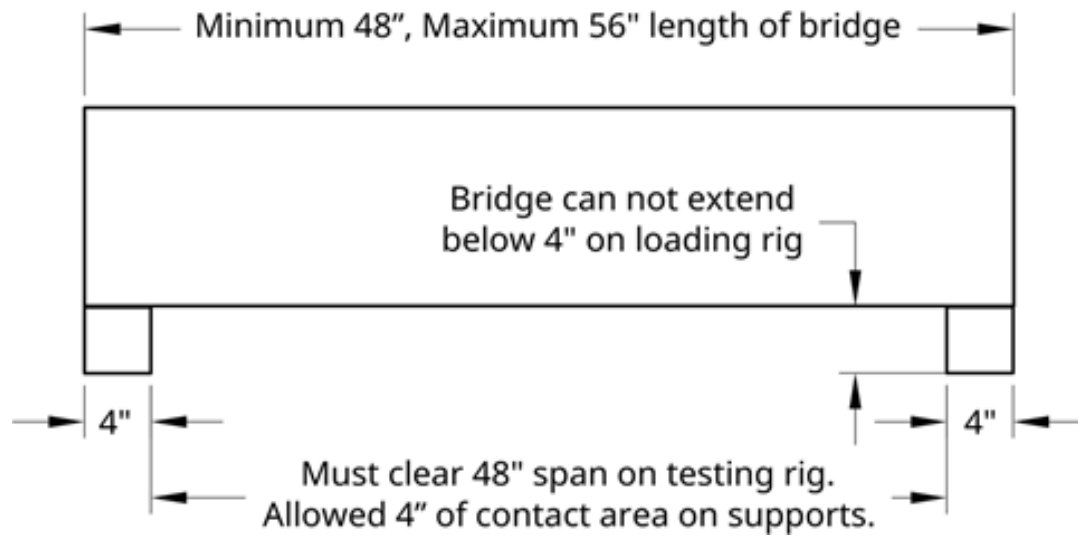


Figure 5 - Profile view of bridge (Not to Scale)

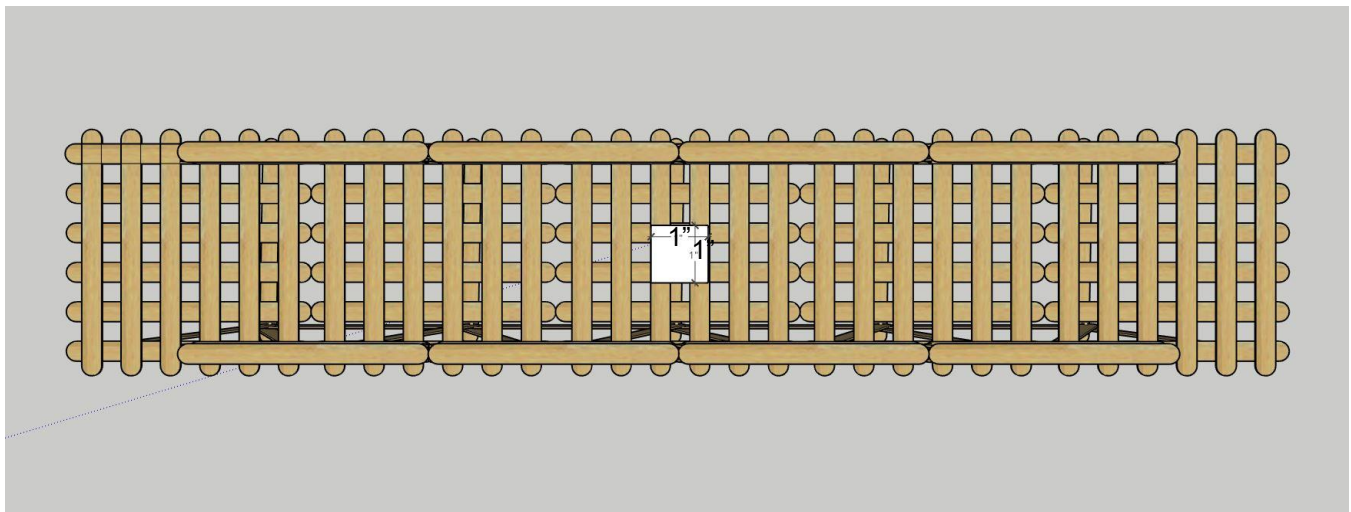


Figure 6 - Center 1" x 1" Hole Requirement (Not to Scale)

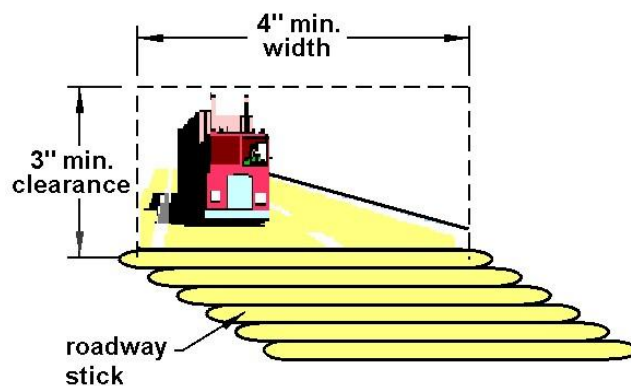


Figure 7 - Roadway Clearance Requirements (Not to Scale)

25th Annual Popsicle Stick Bridge Competition

Rule Violations: There will be a 10-point deduction on the overall score (up to 50 points) for each dimension not met (i.e., if the bridge width is too narrow in width and too short in length, there are two (2) deductions for a total of a 20 point deduction).

Strength and Efficiency (Loading) [20 Points]

- The location of the load application will be at midspan and through the hole opening.
- Bridges must accommodate the loading apparatus, which will consist of a 3"x 3" plate applied to the roadway which will be pulled by bucket filled with sand. See Figure 9.
- The loading area must be clearly marked on bridge.
- The ends of the bridge shall be clearly marked "A" and "B".
- Bridges will be loaded with up to 100 pounds of sand.
- If a bridge fails before 100 pounds, the load at failure (including bucket, loading block and sand) will be weighed and recorded.

Rule Violations: Bridges which cannot accommodate the loading apparatus or testing rig will be awarded 0 points for the Strength and Efficiency (20) Category.

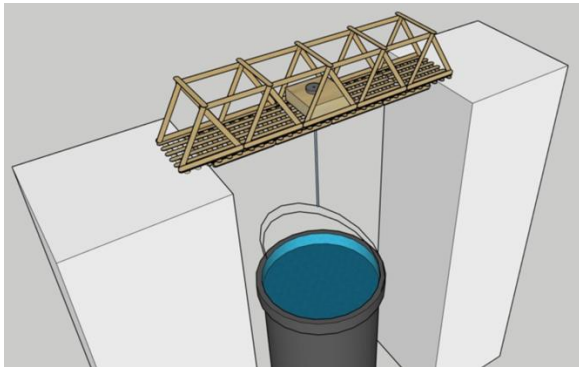


Figure 9 - Loading Configuration

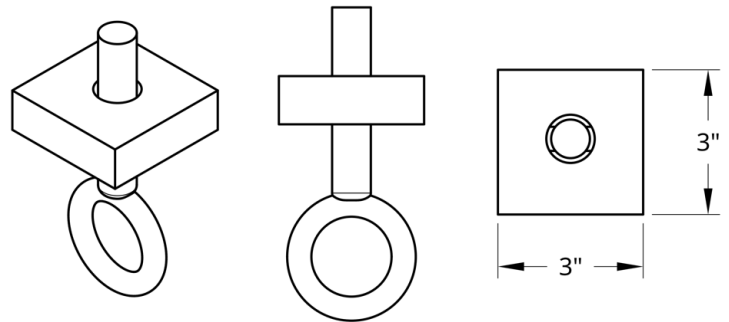


Figure 10 - Loading Apparatus

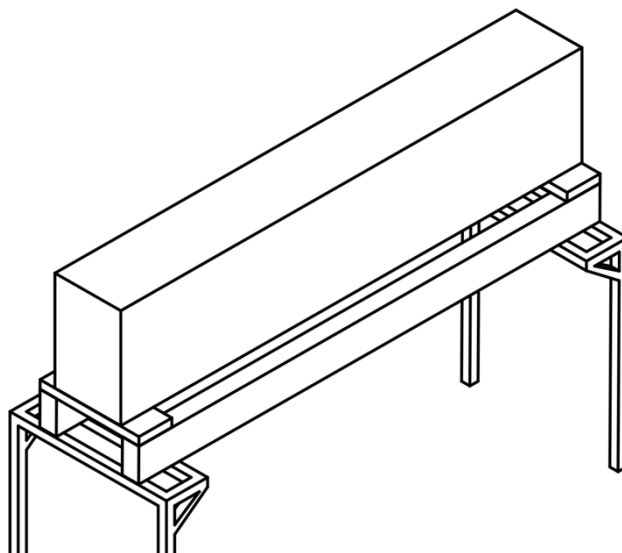


Figure 11 - Loading Configuration in rig

25th Annual Popsicle Stick Bridge Competition

Oral Presentation [15 Points]

- May not be more than 5 minutes long.
- Every team member must speak in the presentation.
- Must address the questions stated in “Stage 3: Presentation” from *Contest Stages*.
- Should briefly explain the design selection process and the construction stage and describe the problems encountered.
- No electronic devices or moving displays are allowed. Props are permitted; however, no power source will be provided. Presentations may not attach anything to the wall.

All presentations will be judged by local members of the engineering and construction community. Presentations may be followed by a brief question and answer (Q & A) session, at the discretion of the judges. Note that the question and answer period is not included in the 5-minute time limit.

Although universal criteria will be used to judge all presentations, some categories are subjective by nature (i.e. workmanship). However, the Judges’ decisions are final. Please note that all members of the judging panel may not witness every presentation. However, all judges will be instructed to use the same criteria when judging a presentation and the panel will confer (with all members in attendance) before naming a winner.

Rule Violations:

- 1 point (out of 15) will be deducted for each additional 30 seconds of presentation.
- 2 points (out of 15) will be deducted for each team member that does not speak.

Display Board [15 Points]

- Every display must contain the following elements:
 - Title (be creative).
 - School’s name.
 - All team members’ names.
 - Graphic representations of the bridge design.
 - Photographic records of the construction process.
- Displays may not exceed the following dimensions: 48” length x 36” height X 18” depth.

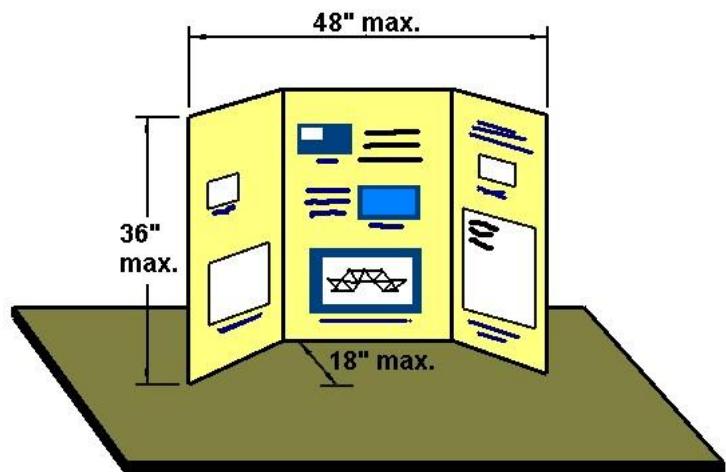


Figure 12 - Display Dimensions

Rule Violations:

- 2 points (out of 15) will be deducted for each missing element from the display board.
- 5 points (out of 15) will be deducted for display boards exceeding the listed dimensions.

25th Annual Popsicle Stick Bridge Competition

Technical Report [25 Points]

- Must have a title sheet with the school, team name, team ID and the team members.
- Body of report shall be 2-4 pages long, not including illustrations or photographs.
- Must be typed in 12-point Arial, double-spaced.
- Must address the questions stated in “Stage 3: Presentation” on Page 8 of the rulebook.
- Must include a drawing with dimensions of your bridge design.
- In addition to the drawing, must include 1 to 4 illustrations and/or photographs with labeled captions that document the construction of your bridge. The dimensioned drawing of the bridge does not count towards this requirement.
- Technical reports must be the original work of the team. It may not be reproduced, recycled, reused from prior years.
- If the technical reports of any teams are same or similar, all teams will be **disqualified**. **Disqualified teams** will not be scored and judged on the day of competition and the sponsoring teacher will be immediately notified.

Rule Violations:

- 2 points (out of 25) will be deducted for each missing element from the technical report.
- Plagiarism will result in immediate disqualification from the competition.

All report submittals are considered final. Only the first submittal will be judged. Reports must be emailed in their Final PDF format to popsicle.bridge@gmail.com by the time frames below:

Early Submittal Bonus: Reports submitted by **Friday, March 1, 2019 at 11:59 PM Pacific Standard Time** will result in 4-points bonus.

Regular Submittal: Reports shall be submitted by **Friday, March 8, 2019 at 11:59 PM Pacific Standard Time** to receive the full amount of points.

Late submittal: Reports submitted after the regular submittal deadline above, shall result in 4-points deduction. The last day to submit reports online via email is **Friday, March 15, 2019 at 11:59 PM Pacific Standard Time**. All other reports beyond this date must be submitted on the day of the competition in paper format.

PDF File Name Format: To standardize our files, teams must submit technical reports by email with the following file structure: **Full School Name_ID Number*_Team Name.pdf**

Example: Los Angeles High School_ID 415_Bridge Builder.pdf

**ID Number provided by ASCE upon online registration. May be requested by email.*

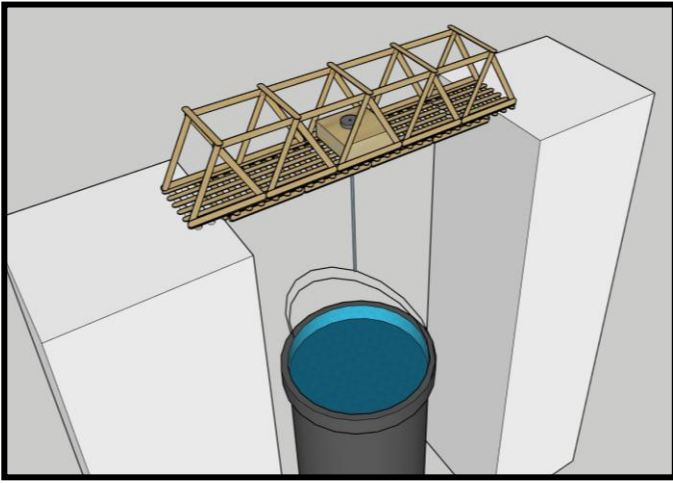
Impromptu Design Competition and Mystery Event [15 Points]

The impromptu design competition is to test every team's skills on an engineering challenge. Materials will be provided, and each team will be responsible for designing something within the rules and conditions given during the competition. Every team will have the same challenge. Details will be provided the day of the event. A Mystery Event will also be presented day of competition. The scores granted during Mystery Event will be used for tie breakers.

25th Annual Popsicle Stick Bridge Competition

Summary

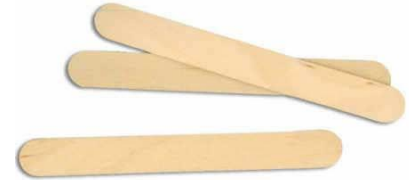
1. Build a Bridge That Can Do This



2. Out of This Stuff



+

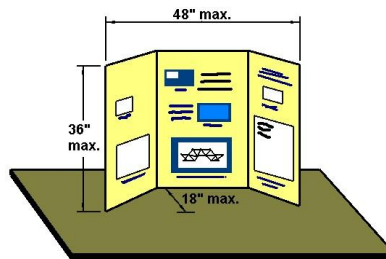


3. Make it Light and Strong

4. Write a Report



5. Make a Poster



6. Present



7. MONEY \$\$\$

(Actually though,
there's a
scholarship cash
prize)