



# SUMMIT COUNTY ENGINEER

## 2023 MINIATURE BRIDGE BUILDING COMPETITION

### GENERAL

Welcome to the 22nd Anniversary of the Summit County Miniature Bridge Building Competition! Participating teams are eligible to win this year's grand prize of \$100 per student and all students that participate are eligible for the MBBC College Scholarship.

The goal of this competition is to foster imaginative design through interactive teamwork, resulting in a miniature bridge that will be judged for its load carrying capacity and efficiency.

### TEAMS

All teams must consist of 2 or 3 students from a Summit County Area High School, Technical/Trade School, or Academy. Academic and Technical Programs consisting of a partnership of multi-county schools are eligible to participate.

Each team must have a teacher/advisor. A school may enter up to three teams in the competition.

**Alternates-** alternates are allowed; however, they are not able to be present at the building tables during the building process and can in NO way help teams construct their bridges.

## MATERIALS

1. The Summit County Engineer's Office will provide one (1) kit of practice building materials to each team to construct a prototype bridge prior to the competition. This kit will include the same materials that will be included in the kit provided on the day of the competition as follows:
  - Twenty (20) Balsa wood sticks, 3/32" x 3/32" x 36" long.
  - One (1) Balsa wood plank, 2" x 3/32" x 18" long which **MUST** be used for the Bridge Roadway. Any leftover portions may be used as each team desires.
  - One (1) copy of 2023 MBBC Specifications.
  
2. Each Bridge Building Team must provide the following materials:
  - **Glue-non-foaming** or adhesive to bond the balsa wood components is to be provided by the student team.
  - One (1) *Matchbox* or *Hotwheels* type '**Test Car**' must be provided by each student team.
  - **Protective Eyewear** is required to be worn by all students during bridge testing.
  - **Construction Plans** and/or **Drawings** must be developed by the students. Drawings may be hand drawn *or* computer generated by programs such as AutoCAD. It is suggested that copies are provided for all team members.
  - **Construction Tools** necessary for bridge fabrication and assembly. It is up to each team to determine what tools they'll need, but here are a few suggestions based on what teams have used in the past.
    - Exacto or Razor knives for cutting balsa wood.
    - Hair dryer for drying glue.
    - Extension cords for hair dryer or other power tools.
    - Rulers or Scales.
    - Pliers and/or tweezers.
    - Clamps.
    - Pins or thumbtacks for aligning pieces.
    - Jig or Template for assembling bridge components.

## CONSTRUCTION PLANS or DRAWINGS

1. Include the following general information on each plan sheet, typically in the lower right corner: a) team name, b) date and c) plan sheet no.

2. **At a minimum**, include the following views, labeling each view and showing the required dimensions:
  - a) **elevation or side view** showing the overall length is 12" minimum and the distance between supports is 12" maximum
  - b) **end or section view** showing the roadbed width is a minimum 1-13/16" clear, the roadbed is no more than 3/16" above the testing table and an overall height dimension
  - c) **top or bottom view** showing the hole for the 1/4" dia. eyebolt and the overall length and width dimensioned.
3. Clearly show that no more than two components are layered or laminated in the views.
4. The Construction Plans or drawings should be submitted to SCE as attachment to an email or hard copy for review and comment at least two weeks prior to the competition. This allows adequate time for SCE to make comments regarding compliance with the MBBC rules and the Team time to revise their design prior to the date of the competition. Changes during the competition is discouraged, however, are allowed with good reason and the approval of SCE.
5. Best Construction Plans Awards - Construction Plans are, in effect, instructions using drawings containing engineering data or details pertaining to geometrics and other elements of the project such as a bridge. The plans show the details that are necessary to construct a specific project and should be tailored to provide all information necessary to accomplish the work in a clear and orderly manner. Clear and concise plans are necessary since most projects are built by contractors or others who typically are not the designers. Project designers in the transportation industry are usually engineers who need to clearly convey their design ideas and details to contractors by means of construction plans and specifications.

**An award will be presented to the respective team that has prepared the "Best Construction Plans" for the following two categories:**

- A. Best Construction Plans *using Manual Drafting*
- B. Best Construction Plans *using Computer Aided Drafting*

\*Please note that the Best Construction Plans Awards are separate from the MBBC Overall Winner, which is based on Bridge Scoring as defined in another section in these rules.

**All teams are required to provide a copy of their approved construction plans no later than at the start of construction of the bridges at the competition. Any changes made to the design or plans during the competition will not be**

### **considered when evaluating the plans for the Best Construction Plans Awards.**

The construction plans will be evaluated by a committee of consulting engineers at the competition. The plans will be judged, and a winner determined for each of the two respective categories based on the following criteria:

- A. Required information is included in the plans as specified in these rules.
- B. Details, dimensions, notes, etc. are shown on the plans are legible and orderly, with emphasis on concise plans clearly showing the necessary information to construct the bridge. Extraneous information is not desired.
- C. The information on the plans portrays the intent of the design and could be constructed by someone other than the designer.
- D. The plans are accurate with respect to the actual bridge that is built.

## **CONSTRUCTION SPECIFICATIONS**

1. All bridges must be constructed **using only the materials provided** in the kit and the adhesives provided by the student team.
2. **Additional replacement materials** will be available in the event of an accidental breakage during the bridge construction competition. Please contact one of the judges or Kristin Schaffner of the Summit County Engineer's office for replacement materials. An even exchange of materials will be given by the Summit County Engineer's representative.
3. All bridges must be constructed entirely by the student teams.
4. Faculty advisors may **NOT** participate in any way in the actual fabrication and/or assembly of the bridge.
5. Only registered team members are permitted at the building tables during construction.
6. All bridge construction must be completed by the student teams during the allotted three-hour competition.
7. **All bridges must span a clear opening of twelve (12) inches.**  
Remember, the bridge will need to be longer than twelve inches to bear on the testing table. The amount of additional length is up to the discretion of the student team.

8. All bridges must have a **minimum 1-13/16-inch-wide roadbed** upon which the *Matchbox* or *Hotwheels* toy car can pass completely across the bridge.
9. The roadbed must be 3/16" or less above the testing table. **The** bridge may **NOT** be coated with any material such as paint, tape, stain, varnish or adhesive.
10. All excess glue must be removed from surfaces that are not bonded together.
11. Square balsa wood sticks measuring 3/32" x 3/32" and a balsa wood plank measuring 3/32" x 2" are provided for construction of the miniature bridge. Two (2) wood sticks may be combined (layered) with glue (laminated) to produce a 3/32" x 3/16" bridge component. Wood sticks and/or a cut-off from the main plank may be glued to one face of the main wood plank (laminated) as long as the combined thickness does not exceed 3/16".

Additional layering or laminating of individual bridge components is prohibited. In other words, no more than two (2) wood sticks may be combined or laminated to create a bridge component, and no more than one-layer wood may be glued (laminated) to one face of the bridge plank.

As the components are combined to construct the bridge, components shall not be joined in manner that creates additional layering or laminating. Additional layering or laminating of individual bridge components separated with spacer blocks is also prohibited. Gusset plates are also prohibited.

Please refer to the attached drawings for examples of allowable and prohibited designs.

To avoid the disappointment of disqualification, each school team is to submit an elevation and cross section sketch clearly depicting each individual balsa wood stick and balsa wood plank comprising the components of their proposed bridge to the Summit County Engineer's Office for review /approval prior to the competition.

Review and approval of the proposed bridge will be for general compliance with these Construction Specifications. However, approval of the proposed bridge does not relieve the student participants from compliance with these Construction Specifications.

**\*NOTE\* - if your team decides to change the design of their bridge prior to the competition the new design must also be submitted for**

**prior approval before the bridge building begins the day of the competition.**

12. Construction of a 'practice' or 'prototype' bridge using the practice kit prior to the day of the competition is highly encouraged. However, the prototype bridges are NOT permitted at the site of the competition.

## **BRIDGE TESTING PROCEDURE**

1. **Completion of Bridge Building** At the conclusion of the 3-hour period, all bridge construction must cease. No additional fabrication or modifications may be made to the bridges after the 3-hour time period. In the event any late alterations are required, points will be deducted as noted below and the team will be allowed a fifteen (15) minute period to complete their alterations.
2. **Holding Station Table** Teams will be directed to display their bridges at the holding station table. At this time, all students will have the opportunity to compare their bridges with those built by other teams. The bridges may then be photographed by the event sponsors for future reference and/or instructional purposes.
3. **Aesthetics Judging:** During lunch, all bridges will be judged by the aesthetics committee. A separate aesthetic award will be presented to the team whose bridge, in the eyes of judges, has '*a pleasing appearance or effect*', and meets the aesthetics criteria for design excellence.
4. **Check Station** After lunch, all student teams will be directed to carry their bridges to the Check Station, where they will be checked according to the following criteria:
  - Each bridge will be measured for specification compliance.
  - Each bridge will be weighed and recorded for determination of design efficiency.
  - Each bridge will be checked for drivability. One end of the bridge will be placed on a 2 ¼" block to produce a 10-degree slope. The 'test car' will be placed on the high end of the bridge and allowed to roll across the bridge. If the car fails to roll completely across, the students may 'restart' the test car from that point. If, after two (2) restarts, the car doesn't roll freely across the entire bridge, points will be deducted.
5. **Construction Plans Judging:** During lunch, all bridges will be judged by the constructions plan committee. Two separate construction plans award

will be presented to the team whose bridge, in the eyes of judges, has met the criteria in the Constructions Plans or Drawings section of the rules.

**Please refer to Bridge Scoring Point Deduction Schedule for details.**

6. **Load Testing** Each student team will then be directed to take their bridge to one of the Loading Tables on the Main Stage. At this time, students should put on their protective wear. All loading and measuring apparatus will be provided by the Summit County Engineer's office. The loading will proceed as follows:
  - A 2" round load plate and 1/4" diameter eyebolt will be attached to the mid-point of the bridge.
  - Ten (10) pounds of weight will be loaded into a five-gallon bucket, which will then be hung from the eyebolt.
  - The student team will proceed to add additional weight to the bucket.
  - The weight carried by the bridge will be automatically monitored and shown on a display screen.
  - The student team will continue adding weight until the point at which the bridge experiences failure. The final weight carried at that point will be entered into the efficiency calculation.
  
7. **Post Failure Analysis** After the bridge failure, the student team will be directed to the Post Failure Table, where a team of structural engineers will analyze the remaining structure to determine its mode of failure and provide important information and reflective insight to student teams regarding their bridge design and construction efforts. If the post failure analysis reveals that the lamination rules in the Construction Specifications were violated, the bridge will be disqualified from the competition.

## **BRIDGE SCORING**

1. **Structural Efficiency-** The Structural Efficiency of each bridge will be determined by the following formula:

$$SE = [W_{SUPPORTED} / W_{BRIDGE}]$$

2. **Final Score-** The Final Score will be the Structural Efficiency minus any deductions due to Late Alterations or Drivability as follows:

$$Score_{FINAL} = SE - [D_{ALTERATIONS}] - [D_{DRIVABILITY}]$$

3. **And the Winner is...** After all scores have been determined, the team with the Highest Final Score will be announced by the Summit County Engineer as the **Champion of the 2023 Miniature Bridge Building Competition!!!**

## **AND FINALLY**

1. During the break and lunch periods, all students are encouraged to visit with our sponsors representing their Engineering firm. The companies represented here today are some of the area's premier consulting engineering firms responsible for designing most of the infrastructure of our area. Today's competition would not be possible without the assistance of these corporate sponsors.
2. Please do not forget about the Summit County Engineer's MBBC Scholarship available to all of today's participants.
3. Special thanks to the staff of the Summit County Engineer's office for once again putting together this event!