



# SUMMIT COUNTY ENGINEER

## 2016 MINIATURE BRIDGE BUILDING COMPETITION

### GENERAL

Welcome to the 2016 Miniature Bridge Building Competition! As a participant in this year's competition, each team is not only eligible to win this year's grand prize of \$100 per student, *but also all student participants also become eligible for the MBBC College Scholarship.*

The goal of today's 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 High School, Technical/Trade School or Academy. Academic and Technical Programs consisting of a partnership of multi-county schools are eligible to participants as well, but all student participants must reside in Summit County. Each team must have a teacher/advisor. A school may enter one or two 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 2016 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 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 **two 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.
10. The bridge may **NOT** be coated with any material such as paint, tape, stain, varnish or adhesive.
11. All excess glue must be removed from surfaces that are not bonded together.

12. 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-offs 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.**

13. 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 PROCEEDURE**

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.

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

5. **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 University of Akron and the Summit County Engineer's office. The loading will proceed as follows:
  - A 2" round load plate and ¼" 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 in to the efficiency calculation.
  
6. **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 2016 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. Special thanks go to the engineering faculty and staff of the University of Akron for developing and handling the weight monitoring system used in today's competition.
3. Please do not forget about the Summit County Engineer's MBBC Scholarship available to all of today's participants.
4. Special thanks to the staff of the Summit County Engineer's office for once again putting together this event!

### **Helpful Websites**

MBBC information, updates, and previous year's winners can be viewed at:

[www.summitengineer.net](http://www.summitengineer.net)

The following websites may also be of assistance when planning your design:

[www.bridgesite.com/funand.htm](http://www.bridgesite.com/funand.htm)

[www.garrettsbridges.com](http://www.garrettsbridges.com)