

2020 Bridge Competition Guidelines

Grades 9 and 10

COMPETITION FOR GRADES 9 and 10

The Competition:

This event is designed to allow students the opportunity to develop a **Deck Arch Truss Bridge** that will be tested for strength-to-weight ratio. Student teams from grades 9 and 10 will be competing against other 9th and 10th grade student teams from around the Richmond Metro area. Interested teams should fill out the attached application and submit it prior to the deadline of **Friday, November 1, 2019** or until all team slots are filled. [Please note there is a maximum limit of 3 competition entries per school.] VDOT will send an entry kit to each team to begin their project. Only materials included in the kit supplied by VDOT can be used in the construction of the bridge. The kit will be shipped to your school by **Wednesday, November 27, 2019** and will include **Balsa Wood and Wood Glue**.

Other materials needed not provided in kit:

- Calculator
- School Supplies

For event planning purposes, a commitment from each student participating is needed by **Wednesday, March 18, 2020**. **The competition will be held at Hermitage High School in Henrico County on Saturday, April 18, 2020**. At the competition, teams will present a 10 minute PowerPoint presentation and structurally test their bridges against teams from other area schools to determine the winning bridge.

Who Can Enter?

- Any student who lives in the state of Virginia.
- Students must be in grades 9th and 10th.
- Teams must be composed of three members, no less, no more.

The Problem:

The goal of this competition is to develop a **Deck Arch Truss Bridge** that will carry as much weight as possible while weighing as little as possible (strength-to-weight ratio). The teams construct a bridge **made only with the materials provided** in the VDOT Entry Kit. Teams should follow the design process and document their project progress.

Each bridge will be checked for design according to the rules. The bridges will be weighed and strength tested during the competition to calculate strength-to-weight ratio.

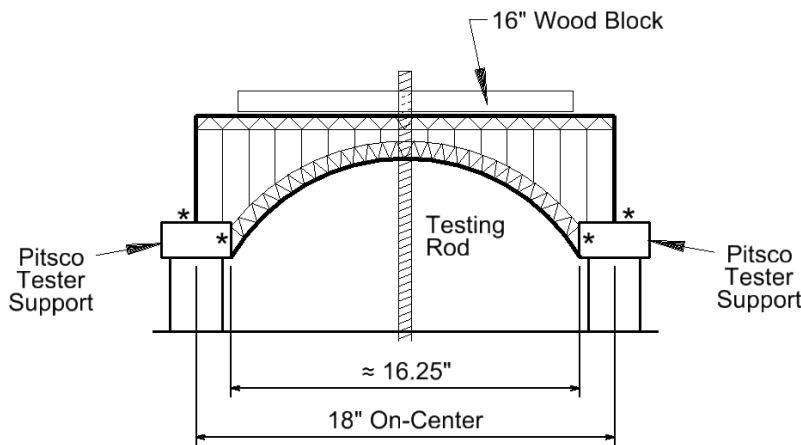
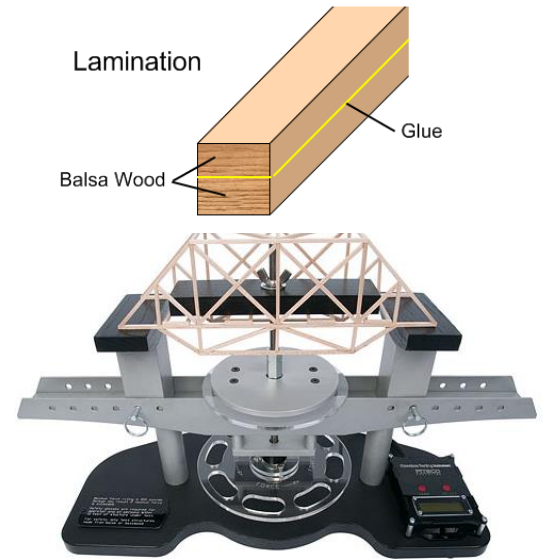
The Challenge:

An engineer's job is to not only design a safe bridge to carry required loads, but also to make sure that it is cost effective (least amount of materials used to achieve the desired load). To simulate this process, teams will use the following strength-to-weight ratio calculation to develop a bridge that carries a high load relative to the bridge weight. Strength to weight ratio is determined by dividing the maximum load carried by the weight of bridge.

Example: Maximum load = 120.0 pounds
 Bridge weight = 20.0 grams
 Ratio = 2724.0
 $[(120 \text{ pounds} \times 454\text{g/pound}) / 20 \text{ g}]$

Specifications for Deck Arch Truss Bridge:

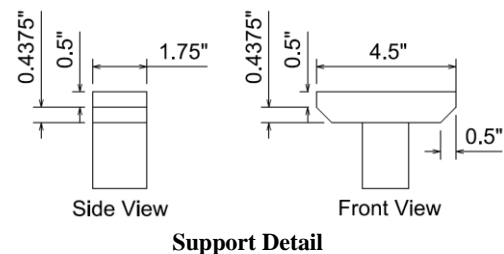
- The materials provided in the kit are the **ONLY** materials to be used when building the bridge structure. Any modifications to the structural properties of the balsa wood or using different glue than provided will result in judges recording zero weight held.
- The instrument used for testing will be the Pitsco Structures Testing Instrument as seen on the right.
- Lamination is permitted one layer only. Lamination is gluing two members along their length as shown in the picture on the right. If two laminated members are beside each other, there must be a minimum 1/8 inch gap maintained between them.
- Butt joints, notched joints, and lap joints are permitted. Lap joints should be no greater than 1/4 inch.
- End to end, the length of the entire bridge must be 18 inches. The bottom chord as seen in the detail below shall be shaped as the arc of a circle or parabola, but does not have to be one single piece of wood.
- The minimum width of the bridge shall be no less than 2.0 inches and the maximum width of the bridge shall be no more than 4.5 inches.
- A block of wood that is 16 inches long by 2 inches wide by 1 inch high must be able to be laid across the top of the bridge deck as shown in the diagram below. The deck is considered the top of the bridge and does not have to be solid.
- Tester supports will be placed at 18 inches on center. Support dimensions are shown below.
- The bridge shall only touch the top and/or front of the Pitsco Tester Supports as seen in the diagram below. If the bridge touches any other part of the tester body, judges will record zero weight held.
- The bridge deck must have a 3/4 inch hole in mid-span to allow a 5/8 inch testing rod to pass through and attach to a 16 inch block of wood for strength testing as seen in the picture to the right and the diagram below. **The rod must be able to pass through the full height of the bridge.**



*Tester Support Surfaces That Bridge Is Allowed To Touch

Tester Configuration Detail

Not representative of required design
Use only for dimension reference



Support Detail

BRIDGE COMPETITION FINALS

Teams attending the 2020 VDOT Bridge Competition will present to a panel of judges comprised of various VDOT Employees. Each team will be expected to make a PowerPoint presentation and be able to answer questions from the panel of judges about their entry. Judges will examine each bridge entry to make sure it fits the specifications given in the rules. The criteria below outline the competition fundamentals:

- A. ORAL PRESENTATION (30% of the total score): Teams will present a 10 minute PowerPoint presentation (a deduction is assessed if over 10 minutes). A rubric on page 7 has been provided for the presentation as a guide.

A drawing or sketch of the final bridge design should be included in the project presentation. Drawings can be digital or hand sketched but should include overall dimensions of the bridge (length, height, and width).

- B. PERFORMANCE (70% of the total score): Achievement of performance goals and stability of construction. Bridges will be weighed and then tested on the Pitsco structural tester. Results will be used to calculate strength-to-weight ratio. Any bridge not meeting the specifications on page 3 will result in judges recording zero (0) weight held.

Awards:

Teams chosen to attend the VDOT Bridge Competition will compete for a:

First Place Team: Gold Medal

Second Place Team: Silver Medal

Third Place Team: Bronze Medal

PREPARING FOR COMPETITION

Form a team of interested students or friends. Discuss the challenges and design specifications. Teams are limited to only three (3) students. Each team must have at least one teacher or other adult to help and advise the group. However, a single adult may be advisor to more than one team.

Study the rules. The individual challenge documents and the grading criteria will give important information, which must be followed if your team is to achieve the best results. Failure to adhere to the rules could lead to penalties, or even disqualification. If any of the information is not clear, please call for additional help.

Plan the timing of the project. Ensure that everyone in the team knows all the deadlines and to complete the bridge.

Notes to Adults: VDOT would like to stress that **the work on all phases of the project is to be done by the students.** Adult assistance is to be limited to:

- Mentoring
- Basic guidance of the students
- Teaching engineering, mathematical and scientific principles applicable to the project
- Guiding students in research
- Assisting in the production of the report and preparation of the drawings
- Overseeing the manufacturing stages of the project

Guidance should be in the form of asking questions, (leading questions if necessary) to promote creative thinking by the students to identify the scientific and engineering principles involved. **Encourage students to consult credible web sites and other resources** to help with the project. **Encourage students to test and improve their designs.** A good way to begin is for each student to design and/or construct a rough prototype. Test it and make improvements.

BRIDGE COMPETITION TIMELINE AND DUE DATES

- 1) Applications due **Friday, November 1, 2019.**
- 2) Supplies will be shipped to schools by the VDOT office by **Wednesday, November 27, 2019.**
Supplies will include:
 - Balsa Wood
 - Wood Glue
 - Information packet
- 3) Commitment to Participate **Wednesday, March 18, 2020.**
- 4) Competition will be held in Richmond **Saturday, April 18, 2020.**

APPLICATION
2019 VDOT DECK ARCH TRUSS BRIDGE COMPETITION
Grades 9 and 10

Email the completed form to Angela Parsley, angela.parsley@vdot.virginia.gov by **Friday, November 1, 2019.**

We have read the challenge documents and the guide to entry, and we want to register.

Name of Adult Advisor _____

Team Name _____

School or Group _____

Address _____

Work Phone _____ Home Phone _____

Cell Phone _____ Fax Phone _____

E-mail address (required) _____

NOTE: Each leader working with different teams at the same school should send a separate application form for each team. **Teams shall have three members.** Copy this form as necessary.

GUIDELINES
2020 VDOT BRIDGE COMPETITION
Oral PowerPoint Presentation: Bridge Competition

Team Name _____

NOTE: This is a rubric for to help for the preparation of the presentation. Oral presentation has a possible score of 100 points. Each category will be judged on a scale from 1 to 20 points.

CATEGORY	20	15	10	5	0	Sub-Score
Content	Covers topic in-depth with details and examples. Subject knowledge is excellent.	Includes essential knowledge about the topic. Subject knowledge appears to be good.	Includes essential information about the topic but there are 1-2 factual errors.	Content is minimal OR there are several factual errors	Did not fulfill requirements	_____/20
Mechanics	No misspellings or grammatical errors.	Three or fewer misspellings and/or mechanical errors	Four misspellings and/or grammatical errors.	More than 4 errors in spelling or grammar.	Did not fulfill requirements	_____/20
Organization	Content is well organized using headings or bulleted lists to group related material.	Uses headings or bulleted lists to organize, but the overall organization of topics appears flawed.	Content is logically organized for the most part.	There was no clear or logical organizational structure, just lots of facts.	Did not fulfill requirements	_____/20
Presentation	Interesting, well-rehearsed with smooth delivery that holds audience attention.	Relatively interesting, rehearsed with a fairly smooth delivery that usually holds audience attention.	Delivery not smooth, but able to hold audience attention most of the time.	Delivery not smooth and audience attention lost.	Did not fulfill requirements	_____/20
Attractiveness	Makes excellent use of font, color, graphics, effects, etc. to enhance the presentation.	Makes good use of font, color, graphics, effects, etc. to enhance to presentation.	Makes use of font, color, graphics, effects, etc. but occasionally these detract from the presentation content.	Use of font, color, graphics, effects etc. but these often distract from the presentation content.	Did not fulfill requirements	_____/20
Total Sub-Score _____/100 Over 10 Minutes: (-20 points) _____ TOTAL SCORE _____						

2020 VDOT BRIDGE COMPETITION
Suggestions and Helpful Hints

1. RESEARCH
2. Check out other bridges in your area or around the world.
3. Include details about your research, design and testing steps, and improvements you made while working on your bridge in your presentation.
4. Students should be prepared for questions at the end of the presentation. These questions may be concentrated in the following topics. However, note that the judges are free to ask any question about any topic. Therefore, each team should be prepared.
 - a) Choice of design
 - b) Civil engineering careers related to bridges
 - c) Safety
 - d) Impacts of bridges
 - e) Lessons learned
5. Stay organized and keep track of time limits.
6. Students can download a student version of Bentley PowerDraft Software that can be used to draw their bridges
 - a) Download link <http://apps.bentley.com/studentserver/home/index>
 - b) See the final page of this packet for the code needed to download the software
 - c) If the PowerDraft software cannot be downloaded, contact Program Manager, Linda Clifton lclifton@aeshto.org .
7. A free structural analysis software is available at http://structural-analyser.com/#tab_view_d
8. Contact your VDOT engineers. They will answer many of your engineering questions.
 - a) Virginia Epperly, P.E.: virginia.epperly@vdot.virginia.gov
 - b) Kwame Sakyi-Bekoe P.E.: Kwame.sakyi-bekoe@vdot.virginia.gov
 - c) Matt Yakim, P.E.: matt.yakim@vdot.virginia.gov
 - d) Raju Iyer, P.E.: raju.iyer@vdot.virginia.gov
9. If you have a question, please contact Angela Parsley.
 - a) Email: angela.parsley@vdot.virginia.gov
 - b) Work phone: 804-328-3047



MICROSTATION: BRIDGE SOFTWARE

Getting started with Bentley's STUDENTserver:

Faculty and students must first create accounts, using the following **School Code** to set up an individual account:

ceUlppmq/CV1ia8npF48K6sfC6t3hqy0JPihQw5FgQ/XzFpJ0krLiA==

Visit STUDENTserver at <http://apps.bentley.com/StudentServer> and click JOIN NOW

Create your account:

1. Add the School Code listed above, as requested in the registration form.
2. Add your personal information in the other form fields.
3. Submit the form, and an Email will be sent to you from Bentley for further verification.
(If you do not see email within a few minutes check you spam/junk folder)

Verify your account:

Click the link in the account verification Email to activate your STUDENTserver account.

Once you verify your new account, you can log in and access all that STUDENTserver has to offer.

Download the software:

- Go to the “download” page on STUDENTserver.
- You can search for the application you want, or browse the options and filter by brand, product line, language, and other options.
- Take note of the “site activation key;” this is what you’ll use to activate the product when prompted during the installation process.
- When you’ve found the application you want, click on the “All Downloads” tab under the product description and find the latest version with your preferred language and download the application by clicking on the green download icon on the right.
- Once the installer is downloaded, open it and follow the instructions. When the product needs to be activated, use the site activation key as described above.

Access training:

- Go to the “Learning” page on [STUDENTserver](#).
- Browse the product categories to find the application for which you want training.
- Click on the blue product name to follow the link to the learning path page on LEARNserver, our training access point.
- Click on the “find training” below the course you want to open up the course materials for download or viewing.
- Once you have completed a training course, you can view and print out transcripts for that course in the “certificate and transcript” page of STUDENTserver.
- To view a list of learning paths recommended for students, go to our learning paths Communities page [here](#).

Get connected:

- Join our Academic Programs community on Bentley Communities [here](#) to get view information on upcoming events, suggested training opportunities, design competitions, and more.
- Join our facebook page [here](#).
- Visit our [YouTube page](#) to view training views, walkthroughs, and more.
- Our library of on-demand videos can be found [here](#) and can be sorted by product and language.

Bentley step by step videos https://www.michigan.gov/mdot/0,4616,7-151-9623_38029_38059_41397-394779--,00.html