2016 MDOT Bridge Competition Guidelines
Grades 9 and 10

The Transportation and Civil Engineering (TRAC) Program

***THE PURPOSE OF TRAC*:** The TRAC program is a new and inventive way of introducing students to the wide variety of career opportunities available in the field of engineering. The program teaches secondary students how to apply a variety of math and science concepts to common engineering problems occurring in transportation systems. The TRAC program is also designed to allow the students to identify and evaluate the social and environmental impacts associated with the development of new transportation systems within their communities.

PROGRAM DESIGN: *TRAC* is designed to be an extended activity created from the Transportation Research Activities Center or TRAC PAC 2. The TRAC PAC 2 includes electronic components to collect and analyze data, and software programs to graph results and test a series of models. The developed activities are designed to show students how to use the tools listed above to solve real-life problems associated with transportation.

COMPETITION FOR GRADES 9 and 10

The Competition:

The bridge competition is designed to be an extended activity created from the TRAC PAC 2 Bridge Builder module. This event is designed to allow students the opportunity to develop a **Vertical-Lift Bridge** that will be tested for mechanics and for strength-to-weight ratio. Student teams from grades 9 and 10 will be competing against other student teams from across the state. Interested teams should fill out the attached application and submit it prior to the deadline of **November 2, 2015**. [Please note there is a maximum limit of 5 competition entries per school. MDOT will distribute kits at trainings and will ship to teachers who attended training last year. Only materials included in the kit supplied by MDOT can be used in the construction of the bridge. The kit will be shipped by **December 4, 2015** and will include **Balsa Wood, Dowel Rods, Wood Glue and String.**
Other materials needed not provided in kit:

- Calculator
- School Supplies

After completing the project, each team is required to submit three (3) proposal copies to Carol Killough. Do not send the bridge itself, but you must include pictures of the bridge (prototype or

final). The proposal must be postmarked no later than **February 19, 2016**. Winners will be notified by **March 4, 2016**. All entries become the property of MDOT and will not be returned. From those proposals entered, three (3) teams from this grade division will be chosen to attend the MDOT Competition Finals at the Clyde Muse Center, Pearl, MS on **April 11, 2016**. At the Finals, teams will present a 10 minute PowerPoint presentation and structurally test their bridges against teams from across the state to determine the winning bridge.

Who Can Enter?

- Students must be in 9th and 10th grades.
- Teams must be composed of three members, no less, no more.

The Problem:

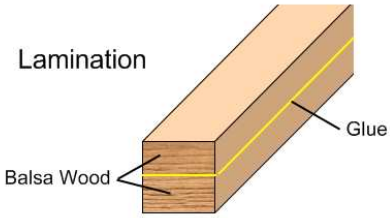
The goal of this competition is to develop a **Vertical-Lift Bridge** that will carry as much weight as possible while weighing as little as possible (strength-to-weight ratio). Each team is to research the bridge type, design and conduct experiments to test for strength-to-weight ratio and lifting operation, and then design a bridge resulting from those experiments. The teams are construct a bridge **made only with the materials provided** in the TRAC Challenge Entry Kit. As a part of the Design Competition, the team is required to develop a report portfolio describing the design and testing of the bridge and create design drawings using Model Smart, Bentley, or other electronic design software. At the competition, each bridge will be checked for design according to the rules and students must demonstrate a smooth lifting and lowering operation to the judges. The bridges will be weighed and strength tested during the competition to calculate strength-to-weight ratio.

The Challenge:

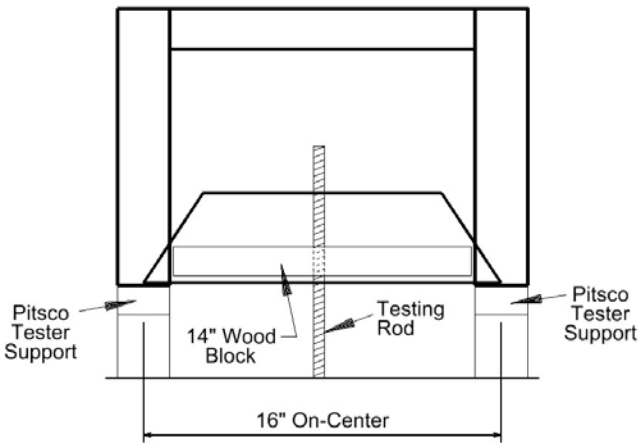
An engineer's job is to not only design a safe bridge to carry required loads, but also to make sure that it is cost effective (least amount of materials used to achieve the desired load). To simulate this process, teams will use the following strength-to-weight ratio calculation to develop a bridge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

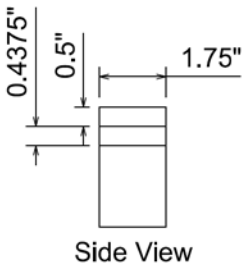
Example: Maximum load = 120.0 pounds
Bridge weight = 20.0 grams
Ratio = 2724.0
[(120 pounds x 454g/pound) / 20 g]

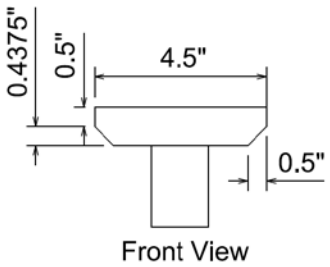
SPECIFICATOINS FOR VERTICAL-LIFT BRIDGE:



- 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 (0) weight held.
- Using materials from the kit create a mechanism that moves the bridge span up and down.
- The instrument used for testing will be the Pitsco Structures Testing Instrument as seen on the right.
- Lamination (gluing two pieces of wood along their longitudinal length to increase strength) is not permitted; however, joints may be thicker to accommodate joining wood pieces.
- The Vertical-Lift span must be 16 inches long.
- The tester supports will be placed 16 inches on center.
- With the bridge lowered, there must be no more than 1 inch of clearance underneath the bridge.
- The Vertical-Lift span must raise high enough at its center to allow a block of wood 4 inches high by 2 inches wide to pass under the bridge while the bridge is open.
- A block of wood that is 14 inches long by 2 inches wide by 1 inch high must be able to be pushed across the bridge deck.
- Tester supports will be placed at 16 inches on center. Support dimensions are shown below
- The bridge shall only touch the top of the Pitsco Tester Supports as shown in the diagram below. If the bridge touches any other part of the tester body, judges will record zero (0) 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 14 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 Detail
Not representative of required design
Use only for dimension reference

Support Detail

PROPOSAL FORMAT:

The information below gives an indication of what the judges are looking for in each section. The proposal is very important because it is how the judges choose which team will be selected for competition. Pay special attention to the required sections below and the proposal assessment on page 10.

I. BRIDGE PROPOSAL (See Page 10 for Assessment)

A. Proposal Format: The written proposal should be typed, double-spaced using a size 12 font of either Arial or Times New Roman on 8.5 x 11 paper with all pages numbered, 1" borders all around.
B. Timeliness: Proposals received after the deadline will not be accepted.
C. Proposal Presentation: Portfolio **MUST** contain all the sections outlined below:

I. Title Page. Include name of challenge, team name, and logo, name of school or organization, names of students, name of teacher or advisor.

II. Table of Contents.

III. Summary (abstract). Clearly and concisely stated. (At least ½ page, no more than two pages)

IV. Introduction. Indicate the team name, team members as well as the background of each member.

V. Body. The main part of the report. This may be divided into several sections (such as Design, Development, etc.). In general, this part should:

a) Explain the scientific principles behind your design.
b) Describe the challenges you encountered in designing your bridge
c) Include Data Tables, Graphic Representation of Tests, and supporting Calculations page.
d) Include scaled drawings of preliminary and final bridge designs.
e) Include at least five (5) pictures of team work during bridge design and construction, along with a picture of the constructed bridge (prototype or final).
f) Explain how you tested your design, and the improvements this led you to make.
g) Describe the challenges that you encountered in building your bridge and how you solved these problems. Include safety precautions, building methods, etc.

VI. Conclusions (and Recommendations). How successful is your project? What did you learn by taking part?

VII. Acknowledgments. List the names of the adults who assisted you in the project with a brief description of what they did. Include a certification, signed by all student team members and adults assisting, stating that: "We hereby certify that the majority of the ideas, design, and work was originated and performed by the students, with limited assistance by adults, as described above."

VIII. Bibliography. List all references used, including Internet, books and magazines.

IX. Appendices. They should include:

A. Scheduling and Accomplishments. Show on a time line, or similar method, how you

scheduled your project. Include *brief* records of meetings, telling how you managed the scheduled.

B. Daily Journal. Progress reports of day-to-day work on the project, including date, performance and comments from each team member.

BRIDGE COMPETITION FINALS

Teams chosen to attend the 2016 MDOT Bridge Finals will present to a panel of judges. Each team will be expected to make a PowerPoint presentation and be able to answer questions from the panel of judges about their entry. Supporting materials may be presented to the judges. Judges will examine each entry to make sure it fits the specifications given in the rules. The bridge brought to competition must be similar to the bridge submitted in the portfolio. The criteria below outline the competition fundamentals:

A. PORTFOLIO (5% of the total score): Previously submitted portfolio's score will be used in the final completion score. The team portfolio must be available for the judges to view at the competition.

B. PORTFOLIO DESIGN DRAWINGS (5% of the total score): Bentley Power Draft CAD drawings of the bridge showcases the team's use of the software. Drawings must at minimum show elevation view of the side and end, along with plan view of the top of the bridge. Bridge dimensions and labels of the views are required. Drawings will be given a maximum of 100 points:
   - 50 points for minimum requirements stated above
   - 50 points for greater detail of bridge components (member thickness, details of joint types, detailed labeling of components, etc.)

C. ORAL PESENTATION (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 11 has been provided for the presentation as a guide.

D. PERFORMANCE (60% of the total score): Achievement of performance goals and stability of construction. The team must demonstrate to the judges that the bridge can lift and lower with ease. 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 MDOT Bridge Finals at the Clyde Muse Center in Pearl, MS, will compete for gift cards of:

First Place Team: $600
Second Place Team: $300
Third Place Team: $150

Each team that sends in a Proposal will receive a Certificate of Participation from MDOT.

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, though 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 the date for submission of the written report, and recognizes that this means that all major development work should be finished before this date.

Keep records of meetings and working drawings carefully, and give members of the team responsibility for different sections of the final report.

Notes to Adults: MDOT 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 library books 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 SCHEDULE

1) Applications due **November 2, 2015**.

2) Packets will be shipped to teams by the MDOT by **December 4, 2015**.
   Packets will include:
   - Balsa Wood
   - Wood Dowels
   - String
   - Wood Glue
   - Information packet

3) Proposals are due **February 19, 2016** (do not include the Bridge).

4) Notification of finalists by **March 4, 2016**.

5) Finals will be held at the Clyde Muse Center in Pearl, MS, on **April 11, 2016**.

APPLICATION
2016 TRAC VERTICAL-LIFT BRIDGE COMPETITION
Grades 9 and 10

Return to Carol Killough by **November 2, 2015**

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

Name of Adult Advisor_____

Team Name_____

Team Members Name & Grade Levels (Team members must be in 9th or 10th grade)

1._____

2._____

3._____

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. Copy this form as necessary. If you do not have the team members' names by the due date, just state that on the application and send that information when it is available.

***Return completed form to**:*
Carol Killough, 645 Hwy. 4 W, Booneville, MS 38829

PROPOSAL ENTRY FORM
2016 TRAC VERTICAL-LIFT BRIDGE COMPETITION
Grades 9 and 10

Return to Carol Killough by February 19, 2016

Enclosed you will find the Report Portfolio for:

Name of Adult Advisor_____

Team Name_____

Team Members Name & Grade Levels (Team members must be in 9th or 10th grade)

1._____

2._____

3._____

School or Group_____

Address_____

Work Phone_____Home Phone_____

Cell Phone_____Fax Phone_____

E-mail address (required) _____

***Return completed form to**:*
Carol Killough, 645 Hwy. 4 W, Booneville, MS 38829

PROPOSAL ASSESSMENT
2016 MDOT VERTICAL-LIFT BRIDGE COMPETITION
Grades 9 and 10

Proposal Format

☐ Typed	(1 point)	
☐ Double Spaced	(1 point)	
☐ 12 Point Font (Arial or Times New Roman)	(1 point)	
☐ All pages on 8.5 x 11 paper	(1 point)	
☐ Information is in the proper order	(1 point)	
☐ All pages are numbered	(1 point)	
☐ Style and presentation	(3 points)	
☐ Mechanics	(3 points)	
☐ Visuals	(3 points)	Score _____/ 15 points

Proposal Presentation

☐ Title page	(1 point)	
☐ Table of Contents	(1 point)	
☐ Summary (no more than 2 pages)	(5 points)	
☐ Introduction	(1 points)	
☐ Body		
o Sections identified	(1 points)	
o Scientific principles of the design	(5 points)	
o Design challenges	(5 points)	
o Tables, Graphs, Calculations	(10 points)	
o Detailed scaled drawings	(15 points)	
o Photos during and after construction	(10 points)	
o Testing and improvements	(5 points)	
o Solving challenges	(5 points)	
☐ Conclusion		
o Recommendations	(3 points)	
o Success of the project	(5 points)	
o What was learned by taking part	(4 points)	
☐ Acknowledgements		
o Adults involved	(1 points)	
o Description of what the adults did	(1 points)	
o Certification and signatures	(1 points)	
☐ Bibliography	(1 points)	
☐ Appendices		
o Schedule on a timeline or similar	(5 points)	
o Daily Journals (must be legible)	(20 points)	Score _____ / 105 Points

Design and Construction

☐ Achievement of design specifications	(30 points)	Score _____/ 30 points

TOTAL SCORE: _____/150 Points

GUIDELINES
2016 MDOT 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	_____

2016 MDOT BRIDGE COMPETITION
Suggestions and Helpful Hints

1. 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

2. Stay organized and keep track of time limits.

3. If you have a question, ASK. You can contact Linda Clifton at *lclifton@aashto.org* or Carol Killough at Carol.Killough@yahoo.com.

4. Contact your DOT engineers. They will answer many of your questions.

5. Check out other bridges in your area or around the world

6. **Include detailed information in the team portfolio. Remember, your portfolio is what determines if your team is selected to come to national competition.**

7. RESEARCH