Maryland Engineering Challenges
2021 Straw Bridge Challenge
Middle School Level – Grades 6 to 8

Supported By:
American Society of Mechanical Engineers, Baltimore Section

Engineer Contacts:
Kevin Capinpin — capinpin@usa.net
Bob Willbanks — rwillbanks.21221@gmail.com

In recognition of the uncertainties resulting from COVID-19, this year's Maryland Engineering Challenge competitions will be held virtually. Competition rules and project requirements are also being adjusted to enable and encourage safe participation for students.

Important Dates

Coaches' Information Session

⇒ **Wednesday, October 21, 2020 6:00 p.m. to 8:00 p.m.**

This "drop-in" virtual event hosted on Zoom is designed for adults interested in coaching a team to chat with engineers. Find out if a particular Challenge is a good fit for your student(s). The Coaches' Information Session is not required and there is no cost. Attendance is strongly encouraged. Contact Jessica at jcelmer@thebmi.org
Access the Information Session from the link below:
http://bit.ly/MECInformationSession
Meeting ID: 835 1931 5106
Passcode: 328410

Registration and Written Report Due

⇒ **Friday, April 2, 2021** **Prior to 4:00 p.m.**

In order to be a registered team, each team must have their adult Coach do the following:

- Register online: http://bit.ly/MEC2021Registration
- Submit the team's **Written Report** (Email in PDF format) to jcelmer@thebmi.org
- AND pay a $5 Coach's Fee, details at https://48278.blackbaudhosting.com/48278/MEC-Coach-Fee

Straw Bridge Submission Due

⇒ **Friday, April 9, 2021** **Prior to 4:00 p.m.**

- Submit your Bridge (by delivery or mailed/shipped) to the Baltimore Museum of Industry at **1415 Key Highway, Baltimore MD 21230**
- Bridge must be submitted by this date in order for it to be tested at the virtual competition.

Straw Bridge Competition

⇒ **Saturday, April 17, 2021** **Program begins at 9:00 AM**

Full details about the virtual Challenge event will be emailed to Coaches after registration deadline, including times and meeting links for viewing the Bridge testing and oral reports.

Questions about Challenge specifications or judging should be sent to the Engineer Contacts:

Kevin Capinpin — capinpin@usa.net
Bob Willbanks — rwillbanks.21221@gmail.com

Other questions?

Jessica Celmer jcelmer@thebmi.org

THE CHALLENGE

Design and construct a model road bridge made exclusively from paper straws, hotmelt glue, and plastic tabs. The roadbed of the bridge must be at least 6 but no more than 7 inches wide. Additionally, the bridge must provide a vertical clearance of at least 3.5 inches. The bridge must span a 20-inch wide hazard with the only support being the 0.5 and 1 inch ledges available at 0.75 and 4.75 inches down from the level of the roadbed, as well as the vertical wall above the uppermost ledge and between the ledges. The total depth of the hazard is 9 inches. The bridge shall be tested to failure. All bridges shall be loaded with a Minimum Initial Load. The Minimum Initial Load is a package of twelve 8 fluid ounce water bottles. The Initial Minimum Load, and how it shall be placed on the top bridge surface is shown in Figure 3. The bridge

should be as light as possible while being able to support as many 8 fluid ounce water bottles as possible. The method of adding additional 8 fluid ounce water bottles stacked on top of the Minimum Initial Load is shown in figure 4.

TEAM REQUIREMENTS

Recommended team size is 2 to 4 students. There is no limit to the number of teams a school may have. Teams of one are permitted.

PERFORMANCE DEMONSTRATION GUIDELINES

- Prior to load testing the bridge will be weighed, to within 1/10 of an ounce, on a postal scale.
- The bridge will be placed in the hazard.
- The bridge load testing will begin by placing The Minimum Initial Load as detailed in Figure 3 onto the top bridge surface.
- Deflection and deformation of a bridge is acceptable. A deflected or deformed bridge must support the applied load for a period of 1 minute in order to be credited for supporting the applied load and before the next 8 fluid ounce water bottle is added.
- If, after a load is applied, the bridge is judged to not exhibit deflection or deformation, the bridge shall be credited for supporting the applied load and the next 8 fluid ounce water bottle shall be added.
- Addition of 8 fluid ounce water bottles will be repeated until the bridge fails to support the applied load.
- The load capacity of the bridge shall be the latest load weight that the bridge was credited for supporting.
- All bridges shall receive a performance score based on the ratio of the load capacity of the bridge divided by the weight of the unloaded bridge., The bridge with the greatest calculated ratio of load capacity to bridge weight shall receive the maximum 35 points. The greatest calculated ratio of load capacity to bridge weight shall be used to normalize all competitor load capacity to bridge weight ratios. The performance score for competitors shall be calculated by multiplying the competitor's normalized load capacity to bridge weight ratio by the maximum 35 points.

DESIGN & CONSTRUCTION STANDARDS

- The bridge must conform to the specifications in this paper; however, credit and awards are also given for ingenuity and creativity.
- While instructors are encouraged to build their own hazards for testing, on the day

of the competition the judges will provide the hazard.

- Due to the method of load application to the top surface of the bridge, the bridge shall not have structure at any height above the top surface of the bridge. The bridge may have any structure below the roadway. The bridge structure may not touch down between the designated support points within the hazard.
- A detailed "Straw Bridge Design Specifications," giving further information and tips, should be downloaded from www.thebmi.org

Allowed materials:

- Drinking Straws: Empress Earth Jumbo Paper Straws, Item # EPS775JWU, 7.75" (available online or from challenge sponsors)
- Hotmelt Glue (low temp recommended)
- Plastic tabs, at the joints only (typically cut from plastic soda bottle or milk jug material)

EVALUATION STANDARDS

All Middle School competitions involve four main components: a written report, an oral report, evaluation of the design and construction of the entry, and the entry's performance under competition conditions. An outline of what is required for each of these, and guidance on preparing for the competition, is given in the "Middle School Guide to Entry", which should be read in connection with this document.

The challenge scoring consists of four parts:

Written Report and Drawings	30 Points

The preferred format of the report is typewritten 12 point double spaced format using a standard word processor program, although points are not deducted for a hand written report. An introduction to preparing a professional report, the "Straw Bridge Written Report Guide" may be downloaded from www.thebmi.org for further information

Oral Presentation	10 Points
Design and Fabrication	25 Points
Performance Demonstration	35 Points

CURRICULUM TIES-- Maryland Engineering Challenges and the Next Generation Science Standards

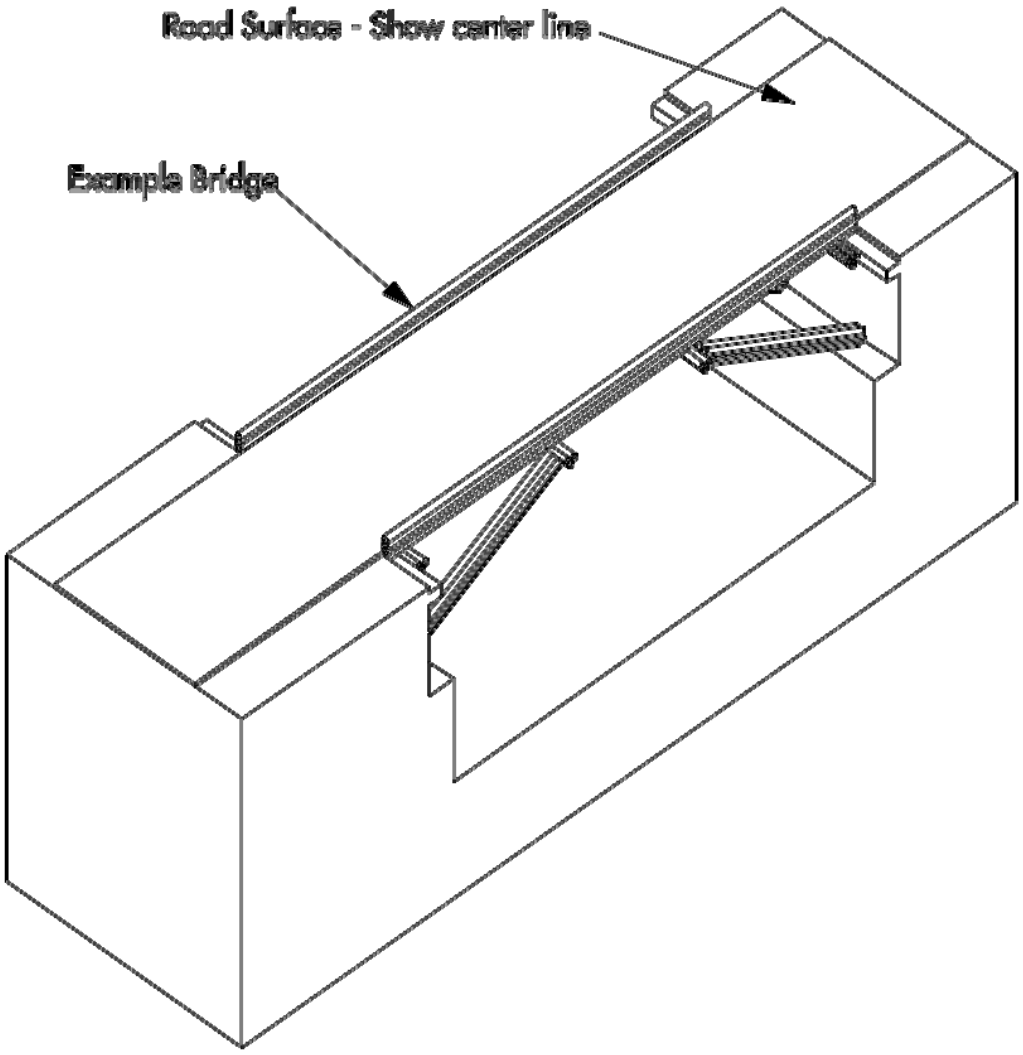
6th-8th Grade - S1.0 Skills and Processes - Topic A. Constructing Knowledge Design, analyze, or carry out simple investigations and formulate appropriate conclusions based on data obtained or provided.	**In preparing for the challenge, students will:** • Develop the ability to clarify questions and direct them toward objects and phenomena that can be described, explained, or predicted by scientific investigations. Objective b • Locate information in reference books, back issues of newspapers, magazines and compact disks, and computer databases. Objective d. • Explain why accurate recordkeeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society. Objective i
6th-8th Grade - S1.0 Skills and Processes - Topic B. Applying Evidence and Reasoning Review data from a simple experiment, summarize the data, and construct a logical argument about the cause-and-effect relationships in the experiment.	**In designing their projects, students will:** • Verify the idea that there is no fixed set of steps all scientists follow. Objective a • Explain that what people expect to observe often affects what they actually do observe. Objective b • Describe the reasoning that lead to the interpretation of data and conclusions drawn. Objective d
6th-8th Grade - S1.0 Skills and Processes - Topic C. Communicating Scientific Information Develop explanations that explicitly link data from investigations conducted, selected readings and, when appropriate, contributions from historical discoveries.	**In composing the written and oral reports, students will:** • Organize and present data in tables and graphs and identify relationships they reveal. Objective a • Explain how different models can be used to represent the same thing. What kind of a model to use and how complex it should be depend on its purpose. Objective e
6th-8th Grade - S1.0 Skills and Processes - Topic D. Technology DESIGN CONSTRAINTS: Explain that complex systems require control mechanisms.	**In building and testing their projects, students will:** • Realize that design usually requires taking constraints into account. Objective c

MAKING MODELS: Analyze the value and the limitations of different types of models in explaining real things and processes.	• Identify reasons that systems fail-they have faulty or poorly matched parts, are used in ways that exceed what was intended by the design, or were poorly designed to begin with. Objective d • Explain that the kind of model to use and how complex it should be depends on its purpose and that it is possible to have different models used to represent the same thing. Objective b • Explain that models may sometimes mislead by suggesting characteristics that are not really shared with what is being modeled. Objective c

GOOD LUCK TO YOUR TEAM!

Reference Drawings Follow

FIGURE 1



Orthogonal Sketch of Simple Bridge
Shown Over Hazard
Road bed must be at least 6"wide

FIGURE 2

Line Drawing showing the pertinent dimensions of the straw bridge hazard. (prepared by Steve Pederson, Contract Engineering Services)

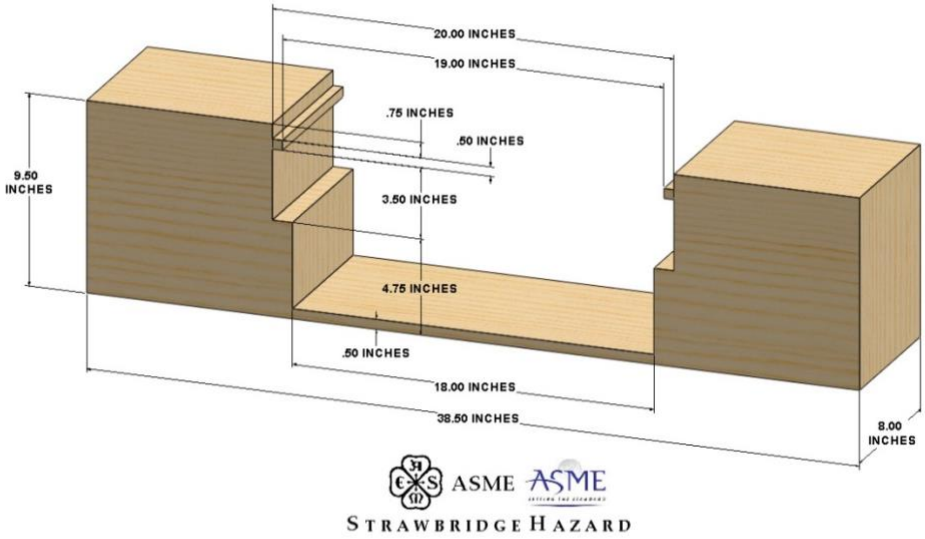
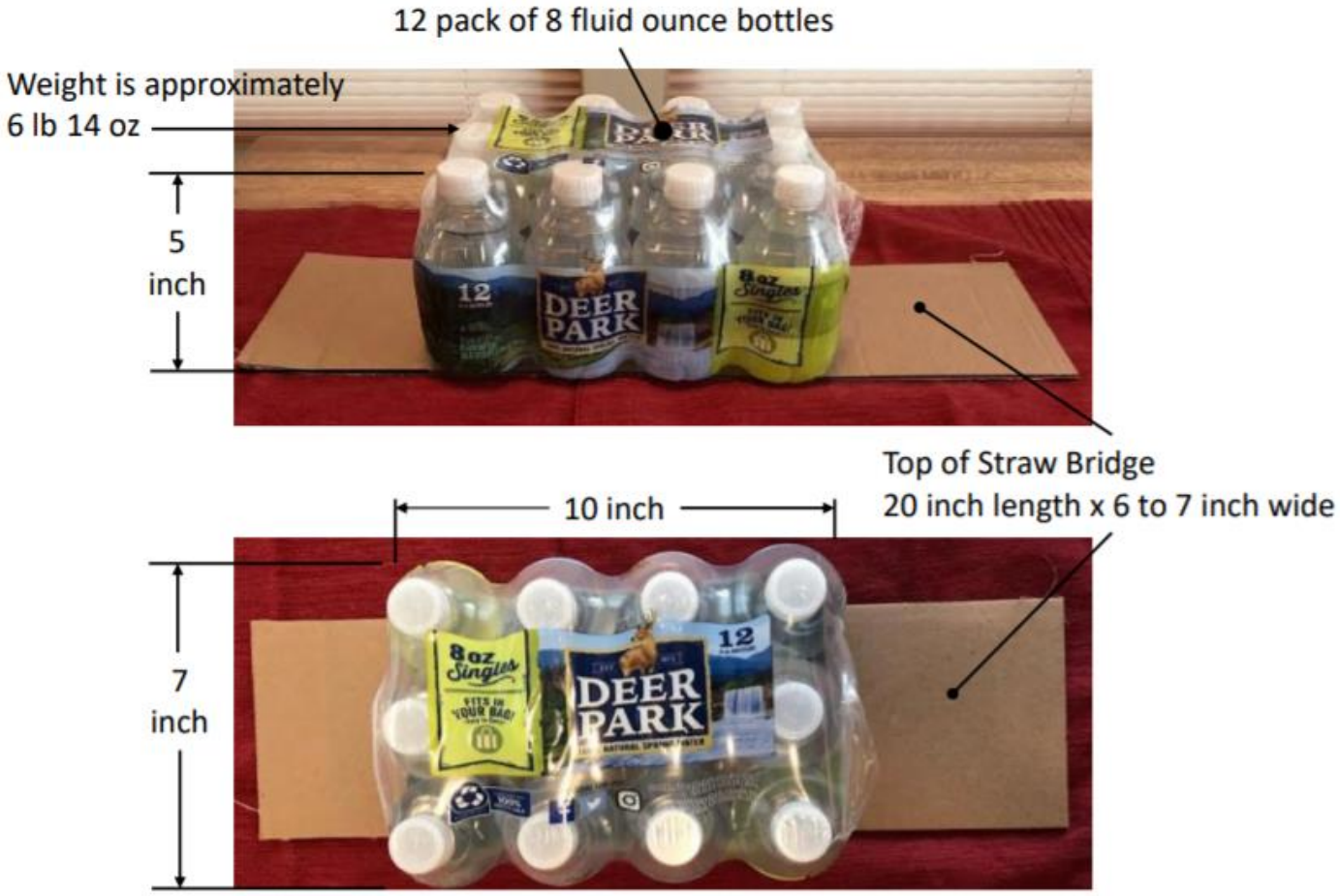
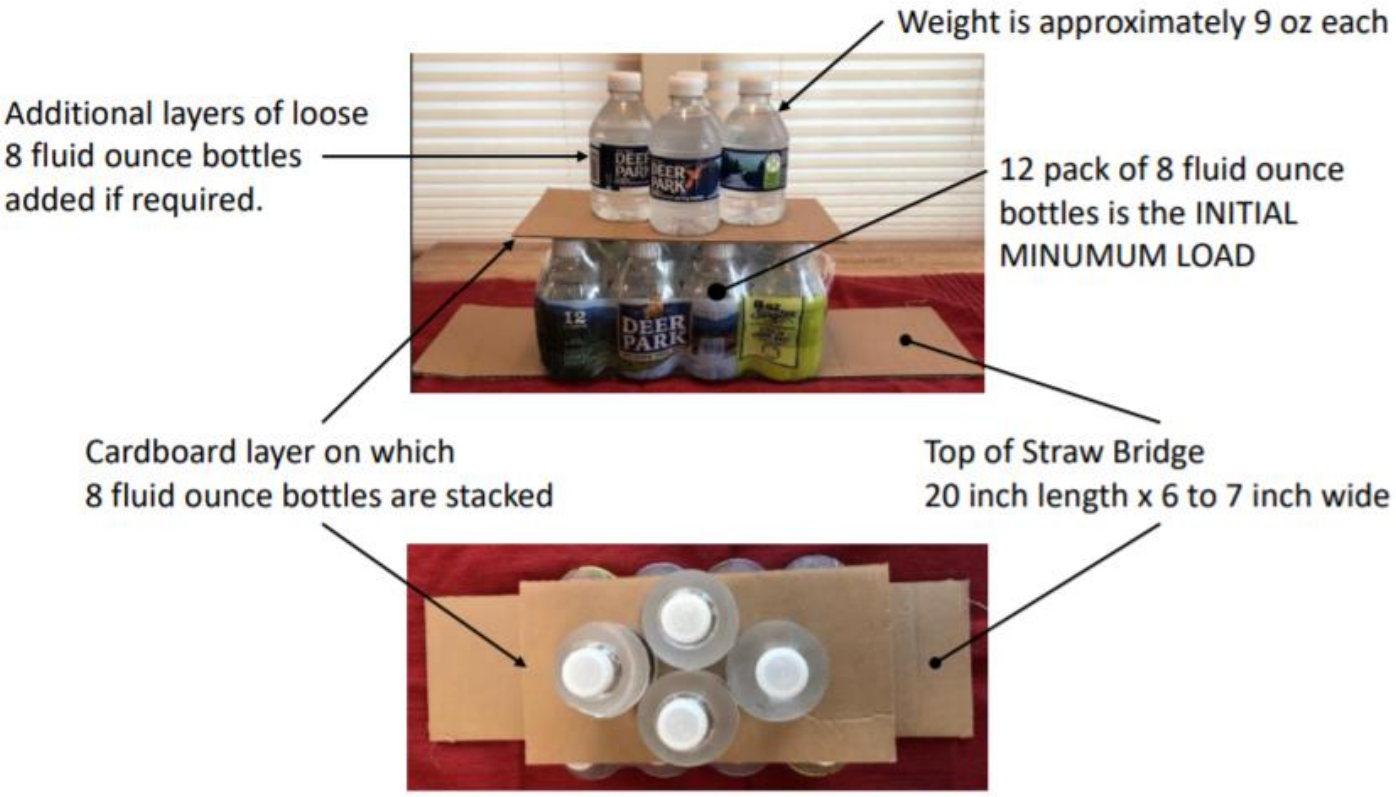


FIGURE 3



MINIMUM INITIAL LOAD THAT ALL STRAW BRIDGES MUST CARRY

FIGURE 4



METHOD TO ADD ADDITIONAL 8 FLUID OUNCE BOTTLES TOMINIMUM INITIAL LOAD.