

Emergency Deployment Bridge Prototype

Natural Disasters often leave structural devastation in their wake. In 2016, southern West Virginia and the surrounding area experienced severe flooding devastation. One such instance was in the Elkview Shopping Center where rapid floodwaters completely washed out a bridge. This bridge was the only access point to the shopping center and left shoppers and their vehicles stranded even after the flooding receded.

In addition to this emergency response scenario, the prototype being developed could be considered for other applications. For instance, the temporary nature of the bridge could be employed to help address one of the Grand Challenges set forth by the National Academy of Engineers (<http://www.engineeringchallenges.org/challenges.aspx>), in particular Restore and Improve Urban Infrastructure. Many bridges need to have serious maintenance completed on them, which could potentially be done more effectively if a temporary bridge could be utilized during the repair.

OBJECTIVE OF PROJECT

The objective of this project is to design a scaled pedestrian bridge structure. This structure has to be at a scale such that the required span of 3 feet represents total span of 90 feet needed in most rescue efforts. The full scale (90 ft) bridge would need to be able to be stored in a standard shipping container until it would need to be deployed, and this shipping container should also be simulated at the scaled dimensions.

Students are to create a model of their solution to this engineering problem in a professional manner. This means not only creating a physical solution to the problem, but to do so using the analysis, planning, control and teamwork tools used by working engineers.

The project grade total is computed in this way:

- 35% technical report - team
- 20% oral presentation - team
- 10% annotated bibliography - individual
- 25% bridge competition – team
- 10% logbook - individual

Additional assignments in project management will be assigned and graded separately from the project.

RULES OF THE PROJECT

1. Structures must be a single unit with all elements permanently connected.
2. The cost of all materials used must be less than \$40, documented with receipts in an appendix of the report.
3. Each group of students may enter only one structure to be evaluated.
4. The bridge must fit in a 16 inch (length) by 3.2 inch (width) by 3.4 inch (height) “shipping container”
5. Each section must support a 2 pound weight as it is expanded (simulating an inspector standing on the bridge)
6. The bridge may be affixed to the deployed from side of the gap, but the structure may only rest on the table at the opposite side of the span.
7. The deployed structure must, support a 2 pound weight placed in the center with < 6 inches of deflection, supported for 10 seconds. Bridges that do not meet this criteria will be disqualified.

8. The width of the gap to be spanned will be 3 feet.

GRADING CRITERIA

You receive BASE POINTS according to this schedule:

20 pts. for Successful Support

10 pts. for Disqualification (including bridges unable to support 2 lbs weight)

0 pts. for No Entry

An initial support test will be conducted. A 2 pound weight will be placed on your initial section. It must support the weight with a deflection less than 6 inches. Failure of this test will result in a disqualification. After that, your team may expand your bridge and test again with the 2 pound weight. After the initial try, you may be permitted to modify your bridge and try again without penalty until class time expires. Highest of your scores will count.

If the structure does not fail (collapse) under the 2 pound minimum, weights will be added until your bridge fails. Your teams' PERFORMANCE POINTS, P, will range from 0-30 with the exact amount determined by structure weight, supported weight, and cost where all values are from teams that successfully supported the 2 lb minimum. Lighter structures, those that hold more, and cost less will earn higher performance points; performance points are determined by the following formula:

$$P = 10 \left(\frac{\text{Mass of Lightest Structure}}{\text{Mass of Your Structure}} \right) + 10 \left(\frac{\text{Your Weight Held}}{\text{Max Weight Held}} \right) + 10 \left(\frac{\text{Minimum Cost}}{\text{Your Cost}} \right)$$

Performance points for disqualified structures or no entry will be 0.

DELIVERABLES:

With the exception of the individual assignment, all submission are 1-per-team.

Individual Background (10%) Due: Jan 27 11:59PM on eCampus

For the individual background research, each team member should select 1 of the following topics such that collectively all topics are researched within the group. Teams may decide they need to explore additional topics, but should research these at a minimum. Team members should cite at least 5 reliable sources per topic. The collection of individual research will be compiled to create the background section of the technical report. ***Hint-Coordinate with your team so all topics are covered***

- Bridge Structures
- History of Cantilevers and How They Work
- Joints Used in Beam Construction / Extension Joints
- Area Moment of Inertia
- Properties of Composites as Applied to Various Materials
- How Adhesives Work (Adhesion / Cohesion)

Bridge Testing (25%) Due: Monday Feb 4 – testing as arranged by instructor

Oral Presentations (20%) Due: Feb 10 11:59PM to eCampus

Technical Report (35%) Due: Feb 17 11:59PM to eCampus, Feb 18 Hard Copy

Logbook (10%) Due: Feb 13 (during class)