

Bridge Design Project

Me 35a (Fall 2009)

The objective of the project is to create an optimal bridge design. An optimal design is one that satisfies all of the design specifications, passes a simulated load test, and costs as little as possible.

Instructions and design specifications:

- Download the 2007 version of the "West Point Bridge Designer" Software:
<http://bridgecontest.usma.edu/download2007.htm>
- Open the file "Contest2009.bdc" file found on the course web site with the "West Point Bridge Designer" software. This file has the bridge construction site. You need to construct a bridge between the two banks of the river.
- The parameters of the construction site are fixed and you are not allowed to change the construction site.
- You are allowed to add as many joints and members as you need
- For each member:
 - Choose a material: Carbon steel, high strength low alloy steel, quenched and tempered steel
 - Choose a cross section: Solid or Hollow
 - Choose the cross section size
- THE DESIGN MUST WITHSTAND THE LOAD TEST BUILT IN THE SOFTWARE
- The software calculates the stress in each member based on the following assumptions:
 - The joints are frictionless.
 - The overall load on the bridge includes its own weight (depends on the design) plus the load of the traffic (does not depend on the design).
 - Failure of the member occurs if it reaches the yield stress or due to buckling (compression only).
Note that contrary to yielding, the longer the member is the more susceptible it is to buckling.
Also, with the same material quantity, tubes are more resistive to buckling compared to bars.
However tubes are more expensive.
- OPTIMIZATION REQUIREMENT: Minimum bridge cost as calculated by the software.

- The calculated cost is affected by the number of joints and cost of each member.
- Cost of each member depends on the material type, the quantity of the material used, and the cross-section geometry.
- For details, press the “Report Cost Calculations” button in the software.
- Additional information regarding effective bridge designs and the principles/assumptions adopted by the software can be found in the software help menu.

Collaboration policy and submission of results:

- The project is to be done in groups of 1-2 students per group. No discussion about the project between students of different groups or with people outside the class is allowed. The only exceptions are: (1) It is allowed to talk to TAs; there will be normal office hours as scheduled, and (2) It is allowed (but not required) to share the cost of your design with other groups.
- Each group is allowed to submit one design only.
- The submitted design must include the student name in the “design title”
(Found in lower right corner - See Figure 1).
- Save the file by the last name(s) of the group member(s), lastname1-lastname2.bdc
- Email your final design (.bdc file) to Marshall at mstead@caltech.edu. Please specify in the body of the message the full names of the group members and the total cost of the design.
- Submission Deadline: November 25th at 5:00pm.

Grading Policy:

- A non-working bridge (i.e., a bridge that fails the load test) will receive zero credit.
- The winning design will earn its designers 5% extra credit in the grade for the entire course.
- Designs with cost lower than 102% of winning design will earn the designers 2% extra credit in the course grade.
- Best designs will be presented in class.
- The grade for each design will be determined with respect to the winning design:
 - Design cost < 110% of winning design → Full credit
 - Design cost = 120% of winning design → 90% credit
 - Design cost = 130% of winning design → 80% credit
 - and so on.