Truss-Bridge design project

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 "West Point Bridge Designer" software from http://bridgecontest.usma.edu/download.htm .
- Open the file "BridgeSite.bdc", found in the course web site, with the "West Point Bridge Designer" software – this is the bridge construction site. You need to construct a bridge between the two banks of the river using a single pier, see Fig. 1.
- It is not allowed to change the construction site (pier location, height, bridge span, etc.)
- You are allowed to add junctions and members as much as you need.
- For each member, choose a material (Carbon steel, High strength low alloy steel, quenched and tempered steel), cross section (solid or hollow), and cross section size.
- The design must withstand the load test built in the software.
- Optimization requirement: minimize bridge cost, as calculated by the software. The calculated cost is affected by: (1) number of joints, and (2) the cost of each member depends on material type, quantity of material used, and cross-section geometry (bar or tube). For details press the "report cost calculations" button in the software main menu.
- 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 a 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 it is susceptible to buckling. Also, with the same material quantity tubes are more resistant to buckling compared to bars. Nevertheless, tubes are more expensive due to higher production costs.
- Additional information regarding effective bridge design, and the principles/assumptions adopted by the software can be found in the software help menu.

Further instructions:

- Groups: 1-2 students.
- Each student is allowed to submit one design only.
- The submitted design must include the students name in the "design title" (found at the lower right corner, see Fig. 1).
- Save the file by the last names of the group member(s).
- Email your final design to Nathalie Vriend at nmvriend@caltech.edu. The title of the message should be "Truss bridge – last name & last name". Please detail in the body of the message the full names of the group members and the total cost of the design.

- Submission deadline: Thursday, November 29th at 4pm.

Grading policy

- The grade of each design will be determined with respect to the design costs of the winning design:
  - ✓ Design costs <110% of winning design ➔ Full Credit.
  - ✓ Design costs <120% of winning design ➔ Credit = 90%.
  - ✓ Design costs <130% of winning design ➔ Credit = 80%.
  - ✓ Etc.
- A non-working bridge will receive zero credit.
- The winning design will grant its designers with 5% extra credit in course grade.
- Designs with costs lower than 102% of the winning design will grant the designers with 2% extra credit in course grade.
- Best designs will be presented in class by their designers.

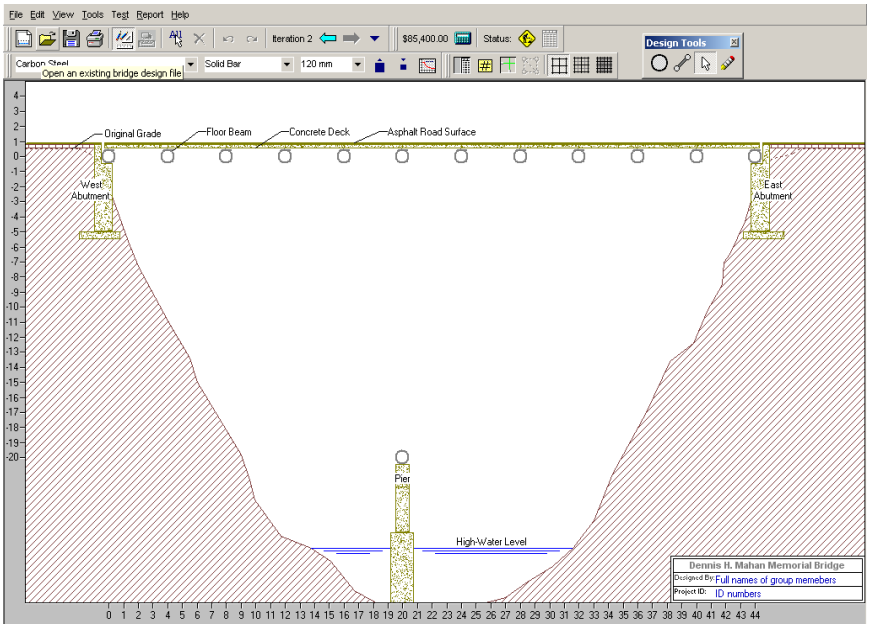

Fig. 1: The construction site