ME 2350 Project (Fall 2022)

Due on Sunday, December 4, 2022 at 11:59 pm on Canvas

Objective

- To design a truss bridge that can support a specified total vertical load distributed over a specified span between two end supports. You will properly document your work with a written report plus any additional media you can provide as a proof of the work.

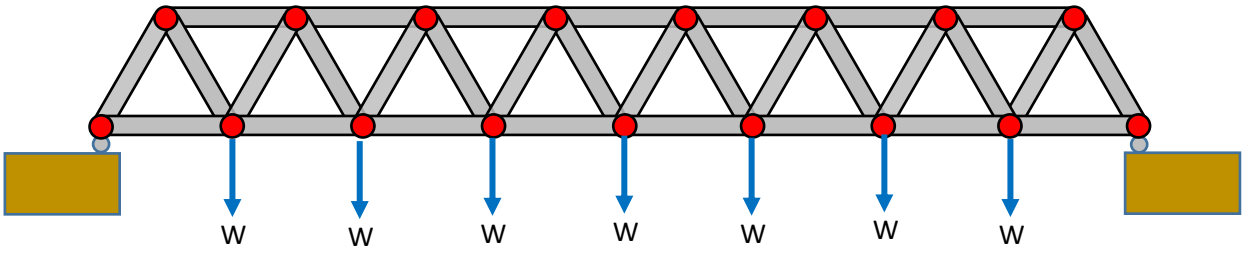

Figure 1. Simple truss bridge illustrasting the problem statement

Desgin requirements

The truss you need to design is to have a span of 20 meters between its end supports, and must support a uniform distributed load of 20 kN/m over that span. This load is the typical weight per unit length of a full freight car in a train. The actual bridge will have two sides supporting the load. However we will be using the total load as a safety factor. The bridge is to be only simply-supported at the ends of its span. To appropriately deal with the load within the context of a truss structure, you are allowed to split the total load into a set of forces applied to the intermetiate bottom joints of the structure.

Constraints

In order to limit the design space (that is the set of all possible design options), in addition to making sure the bridge is a proper truss structure, we are adding a couple of constraints that the design has to meet:

1) All the members in the truss are assumed to have the same limits on the maximal tensile and compressive loads they can sustain. Those values are: 250 kN under tension and 200 kN under compression.
2) The length of all members needs to fall within the range of 2 to 4 meters.

Quantifying the efficiency of your Design

In order to quantify the efficiency of your truss bridge design you are to compute the following “figure of merit”, M:

$$M = \frac{400}{L + aN} \ \text{(kN/m)}$$

Where “L” is the total length in meters of the members used in the truss; and “N” is the total number of members. The parameter “$a = 5$ m”, is used to account for cutting and joining costs.

Reporting on your work

You are asked to document your design in a report of up to **10 pages**. The report should include the following sections:

1. Introduction – Describe the project and design restrictions.
2. Truss Design - Describe your truss bridge design, and the reason you chose that specific design. You will include all relevant analysis that led you to predict that the bridge would support the load appropriately. You need to include a table with the expected forces on all bridge truss members based on your analysis. Any figures you include should be very clear. You may hand draw them as long as the drawing is neat and easy to understand. You may also use software such as PowerPoint, Adobe Illustrator, etc. to create figures.
3. Analysis of Design - Present the figure of merit, M, for your design. Along with the particular value achieved, you are asked to provide an interpretation of what the figure of merit represents.
   You must also include at least one of the additional truss designs you evaluated, along with its own figure of merit. This is an important proof that you have selected the best among the alternatives you tried.

Grading criteria

The grade on this task of your project will depend on multiple factors:

- The creativity/originality of your design (15%)
- The thoroughness of your analytical work (50%)
- The figure of merit of your design, and your explanation of what it represents (20%)
- The technical quality of your report (15%)
  - This includes clarity, conciseness, and thoroughness of explanations
  - Clarity and use of figures to convey information