

CIVL 4122 Truss Design Project

This project aims to design a steel truss bridge to support vehicular loads on a local road. Figure 1 shows the general configuration of the truss. The truss bridge span is 180 ft. It should be wide enough to accommodate a two-lane road with sidewalks and provide minimum vertical clearance for a local roadway.

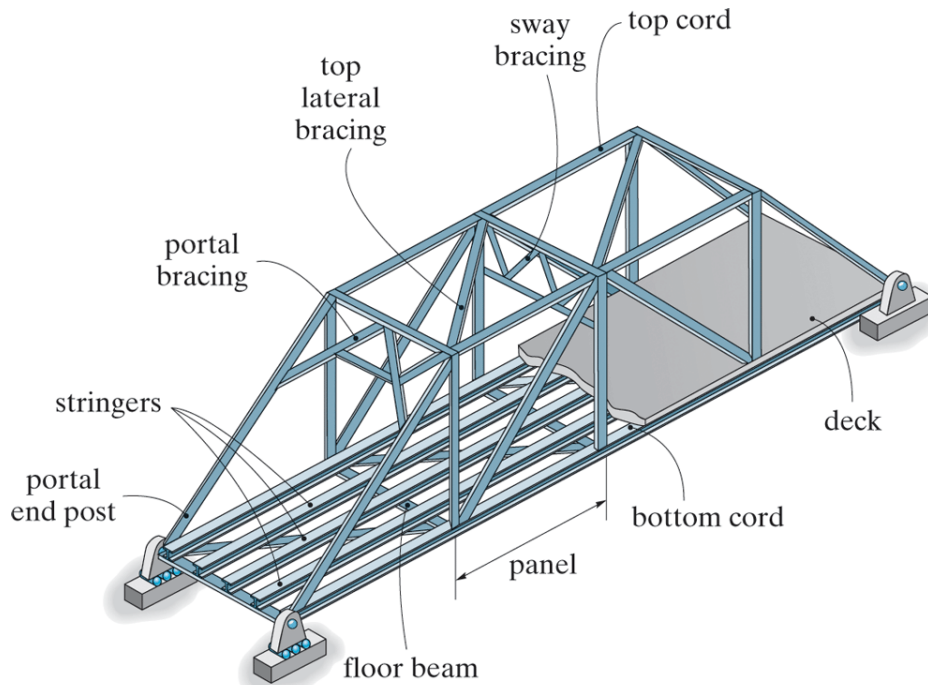


Figure 1. The general configuration of the truss bridge.

Your design should include the spacing of panel sections, the configuration of panel diagonals, the number of stringer beams, and the layout of portal and sway bracing sections. Use the SAP2000 steel frame design tool to size all the elements in your design. Figure 2 shows a typical truss bridge structure.



Figure 2. Truss bridge in West Tennessee.

The floor beams, with diagonal bracing, stringers, and bottom chord members, are constructed from wide-flange beams ("W" shapes). All superstructure truss elements, including the portal end posts, verticals, diagonals, top cord, portal bracing, top lateral bracing, and sway bracing, are constructed using steel tubes bolted to gusset plates at their ends.

Loads on the truss bridge should include dead loads, vehicle live loads, and wind loads. Dead load is the permanent weight of a bridge's structural and nonstructural components, including the roadway, sidewalks, railing, utility lines, and other attached equipment. Vehicle live load refers to the weight of vehicles that cross the bridge. Each vehicle consists of a series of moving concentrated loads, each varying in magnitude and spacing. Wind loads are caused by wind pressure acting on the bridge members. They are dynamic loads that depend on the structure's size and shape, the wind's velocity and angle, and the terrain's shielding effects. For design purposes, AASHTO specifications give wind loads as uniformly distributed static loads.

1. Dead loads are of constant magnitude based on material unit weights. Note that a standard reinforced concrete bridge deck weighs approximately 100 lb/ft².
2. Vehicle live loads are complicated, but for this project, assume a live load on the deck of 250 lb/ft² with a single concentrated load of 50,000 lb. located to develop the maximum moment in the structure.
3. The wind load for the truss is 15 lb/ft on the windward side and 10 lb/ft on the leeward chord. The wind loads for all superstructure types are applied horizontally, at right angles to the bridge's longitudinal axis.

Since uncertainty can be considered using probability theory, there has been a growing trend to distinguish between material uncertainty and load uncertainty. This method is known as strength design or LRFD (Load and Resistance Factor Design). For example, this method uses load factors applied to loads or load combinations to account for load uncertainty. According to the ASCE 7-16 Standard, some of the load factors and combinations that are not to be exceeded include

- 1.4 (dead)
- 1.2 (dead) + 1.6 (live)
- 1.2 (dead) + 1.0 (wind) + 1.0 (live)
- 0.9 (dead) + 1.0 (wind)

In all these cases, the combination of loads is thought to provide the structure with a maximum yet realistic loading.