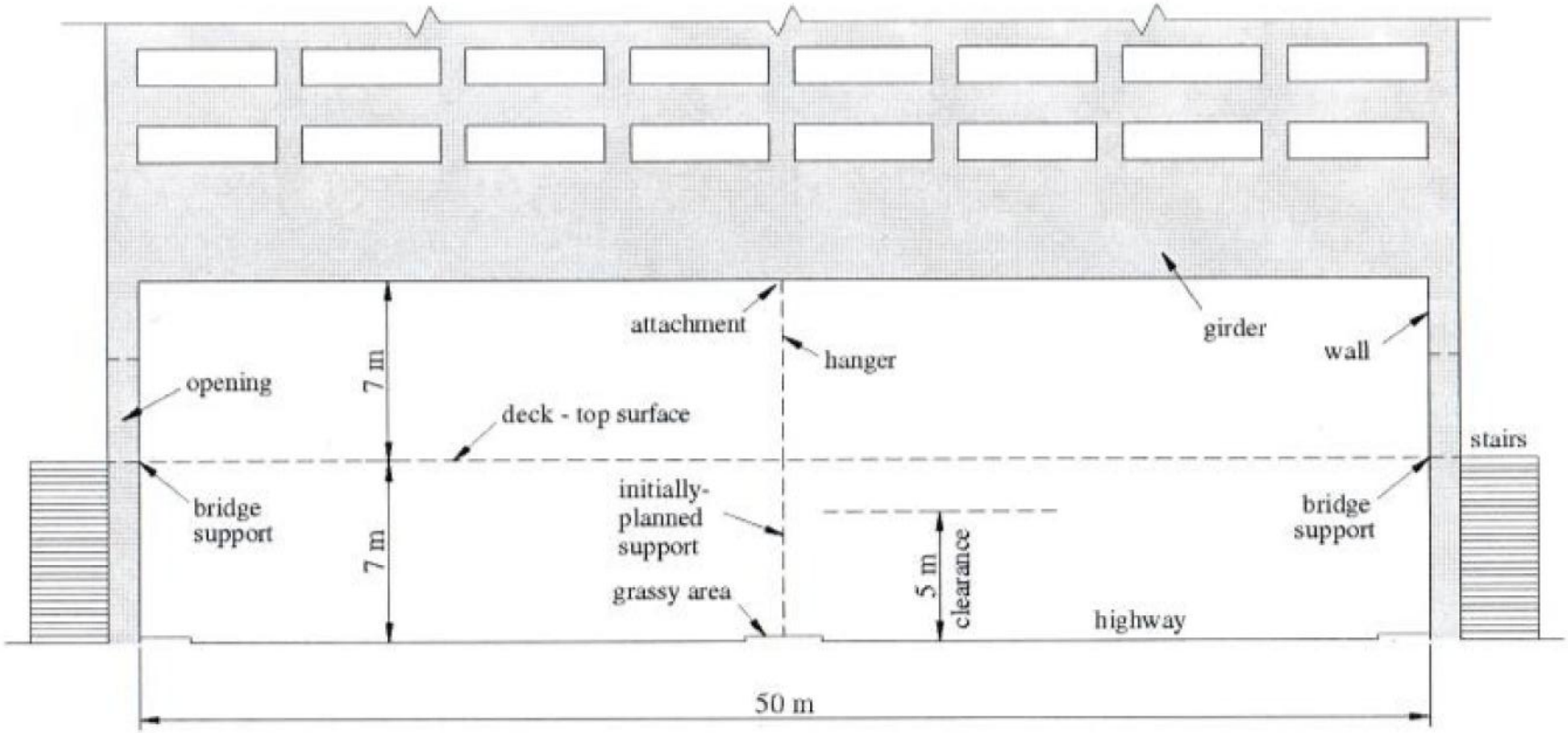
CIV 102F - Design Project - Oct 16, 18, and 19, 2012

An office building has been just built over a highway as shown in the drawing below. The same project requires pedestrian bridge to allow pedestrians to cross over the highway without disrupting the office space. The bridge was initially designed to have a single intermediate support placed in the grassy area between the lanes of the highway. Once the building was built, however, it was decided that the intermediate support makes the bridge vulnerable to a possible impact from vehicles. You have been asked to redesign the bridge by replacing the intermediate support with steel hangers whose top end is attached to the large girder from the structure of the building. The company awarded the bridge contract is a manufacturer of steel trusses, so the bridge must be a steel truss bridge. This bridge should be unique and visually appealing, with 1 m high glass railings and without walls or a roof.

The total distance to be spanned is 50 metres. The design level of the deck is 7 m over the highway with required clearance under the bridge of not less than 5 m. The deck of the bridge must be 4 metres wide consisting of a concrete slab on metal deck, with an overall thickness of 125 mm, which spans between steel beams. The decking will have a total weight of 2.5 kN/m^2. The bridge is to be designed to support a live load of 4.8 kN/m^2. You may assume that the self-weight of the supporting trusses is 0.7 kN/m^2. The design loading due to wind on this structure will be 2.0 kN/m^2 of frontal area.

For This Project:

1. Work only in your assigned group of 2 or 3 engineers. Work independently of other groups.
2. Use a statically determinate steel structure.
3. Decide on how many hanger locations are required (you must use at least one). The end supports of the bridge will be designed by others – refer to item (7) below.
4. The attachment of the hangers to the girder from the existing building is estimated to cost $6,000 per hanger. The estimated cost to provide support at *each* end of the bridge is $1,000 for the first 300kN + $10 for every additional kN of force.
5. Design the steel trusses using hollow structural sections. Assume σ_{yield}= 350 MPa for the steel.
6. Estimate the midspan deflection of the longest span of your structure due to live load. Estimate also the elongation of the hangers due to the same load.
7. Provide the design loads and any other relevant information that will be needed by the engineer who designs the supports where your bridge joins the existing building.
8. Estimate the cost of the bridge and supports. Assume HSS steel structure costs $4000 /tonne, and the concrete deck costs $75/m^2. These prices include both material and erection costs. Note that you need to include the cost of the hangers and attachments.
9. For your report make a neat engineering drawing on 11"x17" paper which *completely* describes your design. In addition prepare a neat set of design calculations (no more than 10 pages).
10. Each group is to maintain a time log for all work on this project. The tasks, and time spent on these tasks, should be clearly recorded for each group member. Indicate the date and times that these tasks were performed.
11. Show evidence that you considered and found a way to reduce costs but maintain efficiency.


attachment
hanger
girder
wall
opening
7 m
deck - top surface
stairs
bridge support
initially-planned support
bridge support
7 m
5 m clearance
grassy area
highway
50 m