

SPECIAL PAPER

ECE 2502: Structural Design III

INSTRUCTIONS

Answer question ONE (compulsory) and any other two questions
Relevant design codes are allowed

QUESTION ONE (30 Marks)

- (a) Design the longitudinal steel for a braced column 500×400 mm bent in single curvature with $f_{cu} = 40$ N/mm² and $f_y = 460$ N/mm² and the following data: effective length about both axes = 6.5 m, unsupported length = 7m, factored load = 2500 kN, factored moments on major axis are 250 kNm at the top and 200 kNm at bottom. The factored moments about minor axis are 120 kNm at top and 100 kNm at the bottom. (20 Marks)
- (b) Briefly describe the steps involved in planning for construction of a bridge in a newly proposed route. (10 Marks)

QUESTION TWO (20 Marks)

A framed building 45×15 m in plan and 60 m in height consisting of storeys 4 m in height. It is braced in the longitudinal direction by rigid frame action and by a reinforced infill wall in the transverse direction. Determine the wind design force on the framed building. Assume that the building is situated in terrain category 3 with basic wind speed of 50 m/s in a fully developed velocity profile. (20 Marks)

QUESTION THREE (20 Marks)

Design a cantilever retaining wall to retain an earth embankment with a horizontal top 3.5 m above ground level. Density of earth is 18 kN/m³, angle of internal friction $\theta = 30^\circ$ and soil bearing capacity is 200 kN/m². Take coefficient of friction between soil and concrete to be 0.5. Adopt grade 25 concrete and high tensile steel. (20 Marks)

QUESTION FOUR (20 Marks)

Design a simply supported reinforced concrete bridge deck slab using a unit strip method. The deck carries a 100 mm depth of surfacing together with a normal HA live load uniformly distributed load of 17.5 kN/m² and knife edge load of 33 kN/m. The deck should also be designed to carry 30 units of HB load. The span of the deck is 12.0 m center to center of bearings.

QUESTION FIVE (20 Marks)

The storage hopper shown in Figure Q5 is closed at the top and is situated in an industrial development and adjacent to a sea. Assuming the altitude of the location to be 5.0 m above sea level, determine the overall horizontal wind loading on the structure, while considering the wind to be acting in the direction indicated. (20 Marks)

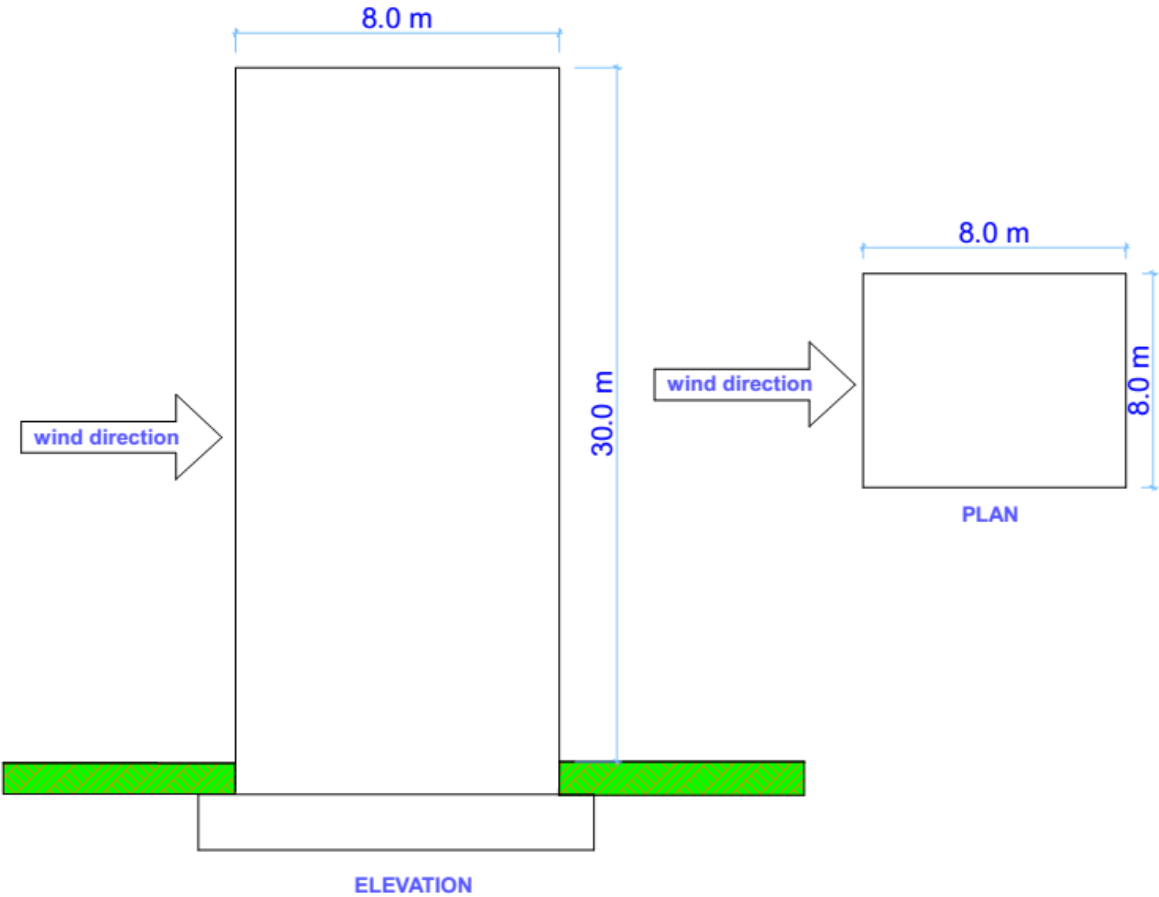


Figure Q5