Dr AL Roy 9/12/2022 E 154

# National Institute of Technology, Hamirpur (HP)

## Civil Engineering Department

**Name of the Examination:** END Semester, DEC-2022
**Branch:** B.Tech. 4th yr. (Structural Engineering)

**Branch**: Civil Engineering — **Semester**: VII
**Course Name**: Bridge Engineering — **Course Code**: CE-451
**Duration**: 3 Hours — **Marks:** 50

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**Note:** Answer the questions as mentioned for each section (Assume any suitable data whenever required). Necessary IS codes (IS-456, IRC-5, IRC-6, IRC-21, IRC-112 etc.) are allowed during the examination. Draw neat sketches whenever required.

### Section – A (Answer any One question)

1. Design a box culvert having inside dimensions of 3 m × 3 m. This culvert is subjected to a dead load of 14,000 N/m2 and a live load of IRC Class AA tracked vehicle. Assume the unit weight of soil to be 18,000 N/m3 The angle of repose of soil is 30°. Use M25 concrete and F 415 steel. Road width is 7.5 m. Span is 3.3 m. (8)

2. Design a Slab Culvert to be on State Highway with the following data.
   Width of bridge: 12.0 m; No footpath provided
   Conditions of exposure: 'moderate'; Materials: Concrete grade M25
   Clear span= 5.0 m; Height of vent= 3.0 m
   Depth of foundation= 1.35 m; Wearing course: 56 mm thick asphaltic concrete
   Steel-Deformed bars to IS: 1786 (grade Fe 415). The design will be made in this section following the current practice for the determination of live load moment. (8)

### Section – C (Answer any One question)

3. (a) Describe Courbon's method of analysis in case of a T-beam and slab bridge with the assumption made in the analysis. (4)

   (b) Obtain Courbon's reaction factor and the maximum bending moment in case of a T-beam bridge having the following details: (4)
   Roadway: 2 lanes; Loading: IRC Class A
   No. of main girders: 3, c/c spacing = 2.6 m
   Span of the bridge: 16 m; Kerb width: 600 mm on either side

4. (a) Describe briefly about the design of Unreinforced Elastomeric Bearings. (3)
   (b) A well foundation is to be designed for an abutment of 10 m × 5 m base dimensions. The well is founded on a sandy soil. The data available are as follows: (5)
   Height of bearing above the maximum scour level: 28 m.
   Permissible horizontal displacement of the bearing level: 50 mm,
   Height of the abutment: 6.0 m.
   Total vertical load including weight of the abutment and well (considering buoyancy effect): 20,000 Kn, Total lateral load at the scour level = 400 kN, Submerged unit weight of soil: 9.5 $kN/m^3$, Design the well and verify the stresses in the steining.

### Section – B (Answer All the questions)

5. Design a RCC tee beam girder bridge to suit the following data:
   Clear width of roadway = 7.5 m; Span (centre to centre of bearings) = 14.5 m
   Live load: IRC class AA or A whichever gives the worst effect
   Average thickness of wearing coat = 80 mm
   Materials: M25 grade concrete and Fe 415 HYSD bars

The preliminary dimensions may be assumed (based on experience) as shown in Fig. 1.

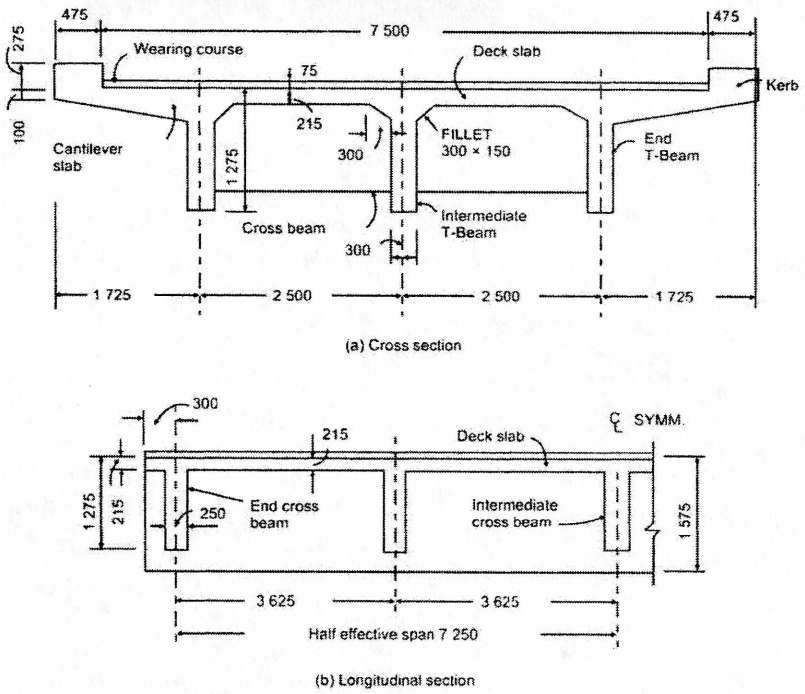


Fig.1 Preliminary Dimensions for T-beam Deck.

Design main girder and cross girder. Sketch the typical details of reinforcements. Sketch the reinforcement details in the component parts of the deck. (16)

6. Design an elastomeric unreinforced neoprene pad bearing to suit the following data:
   Vertical load (sustained): 200 kN
   Vertical load (dynamic): 40 kN
   Horizontal force: 60 kN
   Modulus of rigidity of elastomer: 1 N/mm$^2$
   Friction coefficient: 0.3 (6)

**Section – D (Answer All the questions)**

7. Write short notes on (Any Three): (6)
   a) Expansion Joints & Closed Joints,
   b) Basis For Selection of Bearings,
   c) Elastomeric Bearings,
   d) Sliding Plate Bearings,
   e) Forces on Bearings.

8. Verify the adequacy of the dimensions for the pier shown in Fig. 2. The following details are available: (6)

   Preliminary dimensions: Assumed as in Fig. 2.
   Superstructure: T-beam two- lane bridge of effective span 16.1 m, Overall length = 17.26 m;
   Type of abutment: Reinforced concrete
   Loading: As for National Highway;
   Back fill: Gravel with angle of repose 0 = 35°
   Unit weight of back fill, w = 18 kN/m$^3$

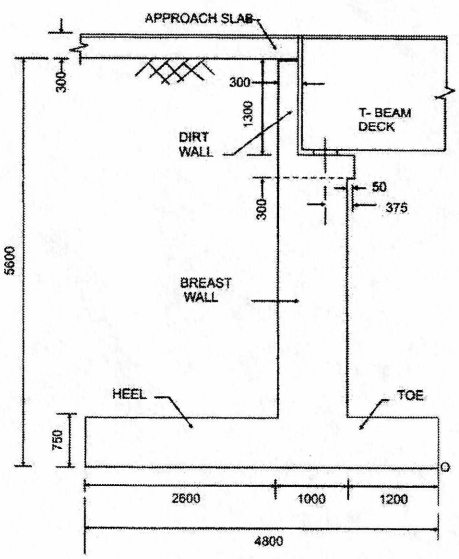


Fig.2 Preliminary Dimensions of Abutment

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