[Total No. of Questions - 9] [Total No. of Printed Pages - 4]
(2066)

16107(J)

B. Tech 6th Semester Examination

Bridge Engineering (NS) June-16

CE-321

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : (i) Attempt one question each from Sections A, B, C and D. Sections E is compulsory. All questions carry equal marks.
(ii) All Dimensions (Distance & Force units) are in "m & kN" except when specified otherwise (S.I Units).
(iii) Assume necessary data wherever required/missing.
(iv) Course related IS & IRC codes are allowed for Exam.

SECTION - A

1. (i) What are the Components of a bridge structures?
(ii) Discuss the different ways in which bridges may be classified?
(iii) List the points to be considered for suitable site selection for a major bridge across a river.
(iv) What are the factor to be considered in the determination of design discharge linear water way and economical span length?
(v) Distinguish between vertical clearance and freeboard. (5×4=20)

2. (i) What is the importance of subsoil exploration in the design of a major bridge? List the data to be obtained from such an exploration.
(ii) Why should a vertical clearance above HFL be provided? State typical values of clearance for girder bridges and arch bridges
(iii) What is meant by economical span length? Derive the condition for an economical span, stating clearly the assumptions made in the derivation.
(iv) Distinguish between normal depth and maximum scour depths. How would you estimate the maximum scour depth for any bridge pier?
(v) Discuss the factors influencing the choice of the type of bridge and its basic features. (5×4=20)

SECTION - B

3. Design a R.C.C Slab Culvert to be on State Highway for IRC AA Wheeled Vehicle Loading with following data:
Width of Bridge (B) =12m
Condition of Exposure: Moderate
Materials: Concrete Grade M35; Steel Grade Fe415 **[P.T.O.]**

Clear Span (L) =6m; Height of Vent (H) =3 m
Depth of Foundation m
Wearing Course Thickness=100 mm
Width of Bearing = 400 mm
Design the following:
(a) Geometrical Design of R.C.C Slab culvert.
(b) Reinforcement Design for dead load of R.C.C Slab culvert and IRC AA Wheeled vehicle live load.
(c) Draw a neat sketch of reinforcement details of above R.C.C Slab culvert Parts. (20)

4. Design a R.C.C Box Culvert to be constructed on State Highway for IRC 70R Wheeled vehicle load with following data & Sketch the details of reinforcements in the box culvert
- Clear Vent way: l =4.5m x h=3.0m
- Superimposed D.L on culvert = 10 KN/m^2
- Density of soil (γ)= 18 KN/m^3
- Angle of Repose or angle of friction of soil =30°
- Materials: Concrete grade M35 & Steel grade Fe415

Design the following:
(a) Geometrical Design of R.C.C box culvert.
(b) Reinforcement Design for mid span and support of box culvert bottom slab.
(c) Reinforcement Design for mid and support of box culvert wall.
(d) Draw a neat sketch of reinforcement details of above R.C.C box culvert Parts. (20)

SECTION - C

5. Design a deck slab of R.C.C T- girder deck Slab Bridge to be on national Highway for following IRC Loading with following data & Sketch the details of reinforcements in the R.C.C T girder deck Slab Bridge.
- No of spans=4; Single span length (L)=20m
- Width of bridge (or) Clear road way (B)=7.5m
- Assume 3 nos T beam (Longitudinal Girder (Main beam) in long direction) @ c/c spacing of 2.5m
- 5 nos cross beams @ 5 m c/c intervals
- Condition of Exposure: Moderate
- Materials: Concrete grade: M20; Steel grade: Fe415
- Wearing course thickness (D_w)=100mm
  (a) Calculate the bending moment of simply supported deck slab due to Dead load
  (b) Calculate the bending moment of simply supported deck slab due to IRC Class AA wheeled Vehicles live load(Consider any of 3 wheels only)
  (c) Reinforcement design of simply supported deck slab for Dead load and IRC Class AA wheeled Vehicles live load. (Consider any of 3 wheels only)
    (i) Longer span Flexural reinforcement.
    (ii) Shorter span Flexural reinforcement. (20)

6. Design an Inner Longitudinal girder R.C.C T- girder deck) Bridge to be on National Highway for following IRC Loading with following data & Sketch the details of reinforcements in the R.C.C T girder deck Slab Bridge.
   - No of spans=4; Single span length (L)=20m
   - Width of bridge (or) Clear road way (B)= 7.5m
   - Assume 3 nos T beam (Longitudinal Girder (Main beam) in long direction) @ c/c spacing of 2.5m
   - 5 nos cross beams @ 5 m c/c intervals
   - Condition of Exposure: Moderate
   - Materials: Concrete grade:M20; Steel grade:Fe415
   - Wearing course thickness(D_w)= 100mm

   (a) Calculate the bending moment due to Dead load
   (b) Calculate the reaction factor of inner and outer Longitudinal girder due to IRC Class B Train of Vehicles live load by Courbon's method
   (c) Calculate the bending moment of inner Longitudinal girder due to IRC Class B Train of Vehicles live load by Courbon's method
   (d) Reinforcement design of Inner Longitudinal girder for Dead load and IRC Class B Train of Vehicles live load
      (i) Flexural reinforcement.
      (ii) Transverse (or) Shear reinforcement. (20)

SECTION - D

7. For an Abutment on a national highway to suit the following data:
   - Preliminary Dimensions: Assumed as in Fig. 1.
   - Superstructure: T-Beam (Two Lane) bridge of Effective span (L_{eff}) = 20m Overall Length (L) =22m
   - Type of Abutment: Reinforced Cement Concrete
   - Loading: As for National Highway
   - Backfill: Gravity with Angle of Repose (ϕ)=40°, Unit Weight of Back fill (γ_{earth}) =18kN/m^3 and Angle of Internal Friction of soil on wall (μ or z) =17.5°
   - Approach slab: R.C slab 350 mm thick, adequately reinforced
   - Load from Superstructure per running m of Abutment wall:

     Dead load = 250 kN/m; Live load=124 kN/m

     Carriage way width of bridge=8.5m
   - Bearings: Neoprene Pads of overall size 0.4m*0.6*0.07m,

     Embedding 5 plates of 3mm thickness and 6 mm clearance in plan G=1kN/mm^2

     Check the adequacy & stability of the assumed section on the bases of stresses developed. The reinforcement details are not required to be computed. (20)

[P.T.O.]

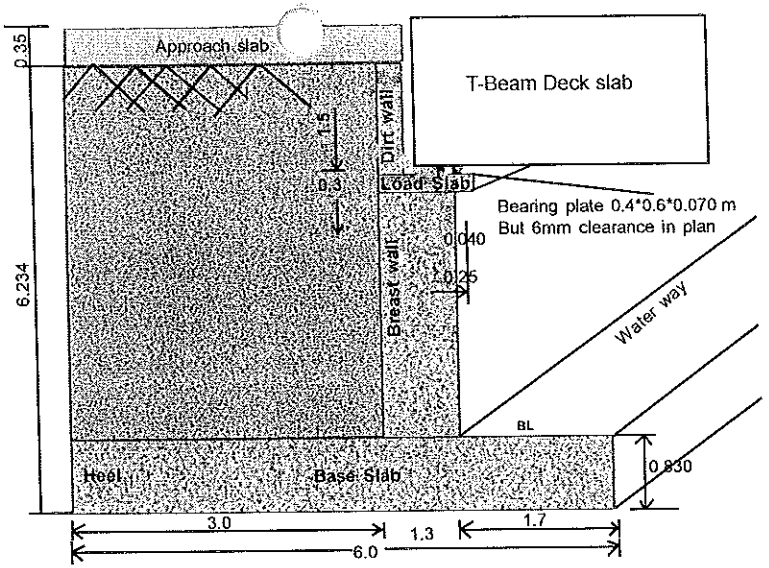

Fig. 1

8. Design a suitable R.C.C well foundation for the pier of a major highway bridge using the following data:
   Internal diameter of well (d_i) = 3 m
   Type of soil strata (sandy): (K = 0.030)
   Depth of well (L) = 20m below bed level
   Materials: M20 Grade concrete & Fe415 bars
   Design the following design components of well foundation:
   (a) Geometrical Design of well Steining and well curb
   (b) Reinforcement Design for well Steining and well curb
      (i) Vertical (longitudinal) Reinforcement
      (ii) Traverse(Hoop) reinforcement (20)

SECTION - E

9. (i) What is the function of bearings in bridges? Sketch the details of bearings for a submersible bridge.
   (ii) What is the function of an approach slab?
   (iii) Describe Courbon's method for load distribution and indicate the limitations.
   (iv) Describe Hendry-Jaegar method for load distribution and indicate the limitations.
   (v) List the Indian railway standards to be followed in the design of railway bridges. State the gauges used in Indian railway bridges.
   (vi) How would you compute the pressure on a pier due to water currents?
   (vii) What are the causes for longitudinal forces on bridges?
   (viii) What are the causes for buoyancy effect on the bridge pier design?
   (ix) What are the considerations in determining the effect of wind loads?
   (x) Discuss the procedure for computing earth pressure on an abutment. (10×2=20)