Ref No. – **Ex/CE/5/T/506A/2024**

BACHELOR OF ENGINEERING (CIVIL ENGINEERING) 5th YEAR 2nd SEM. EXAMINATION 2024

BRIDGE ENGINEERING

Time: 3 Hours **Full Marks:** 100

(50 Marks for each Part)

Use a separate Answer-Script for each part

Q1. is compulsory and answer any two from Q2. To Q4.

Part-I

(Assume any data, if required, reasonably, Use of Code is not allowed)

1. An engineering consultancy organisation is awarded to prepare a Detailed Project Report (DPR) for construction of a road corridor. The Corridor crosses over several major and minor streams which are to be overcome by construction of bridge. The corridor also crosses several at-grade road which are to be crossed through several underpasses. What will be governing parameters for the followings. State with very brief reasons.
   a) What if not streams are crossed through embankment but not bridges.
   b) What if the at-grade junctions are crossed at-grade without construction of underpasses.
   c) The lane configuration of the bridges and underpasses.
   d) What should be the design criteria for construction of the underpass.
   e) What should be the design criteria for construction of bridges across rivers/streams.

   (5x2=10 marks)

2. A continuous bridge is to be constructed on a sandy soil with a simply supported PSC span of 30m between c/c of the foundation/pier. The pier of the bridge shall rest on pile foundation of 4 nos. with symmetric configuration i.e. 2x2 matrix. The diameter of the circular bored cast-in-situ pile is 1.0m and the c/c distance between piles in both longitudinal and transverse direction shall be 3 time the diameter of the pile. Protrusion of the pile cap beyond face of the pile shall be 150mm. Thickness of the pile cap shall be 1.5 times the diameter of the pile. The pile cap is embedded in the soil by 0.5m. Dimensions and other parameters of the bridge shall be as under:
   a) Pier size = 3x3m.
   b) Height of the pier = 8.0m
   c) Dimension of the rectangular pier cap is 10mx3.5mx1.5m. 1.5m is the depth.
   d) Height of the bearing + pedestal = 500mm.
   e) Depth of the superstructure = 3.0m
   f) Dead Load + SIDL of superstructure = 2000 tons.
   g) Braking force along longitudinal direction = 50.0tons.
   h) Centrifugal force = 10.0tons.
   i) Consider a shift of 150mm along both longitudinal and transverse direction.
   j) Unit weight of RCC = 2.5t/m^3.
   k) Unit weight of the soil = 2.0t/m^3.

   i. Derive the maximum and minimum pile reaction.
   ii. What should be the size of the footing (L) if the bridge is to be constructed provided width along transverse direction (T) is 8m and depth of the footing is 1.5m. Safe Bearing Capacity (SBC) of the soil is 30.0ton/sq.m (Hints: P/A ± M/Z=SBC).

   (15+05=20 marks)

3. a) What should be the Safe Bearing Capacity (SBC) of the soil in which a Circular well foundation is to be constructed to sustain/support the following loads:

a) Depth of well = 45m.
b) Dia of well =12.0m.
c) Depth below max scour = 20.0m.
d) Horizontal force of 138.0t acts at 40m above the base of well under seismic load combination.
e) Weight of superstructure = 975.0 tons.
f) Weight of pier = 185.0 tons.
g) Weight of well = 1050.0 tons.
h) Soil around the well is mixed type having C=0.25kg/cm^3; φ=32 degrees; γ(dry)=1750kg/m3.
i) Permissible bearing capacity of soil is 48 ton/m^2. FOS is 1.6 for seismic case and 2.0 for non-seismic case.
j) Do not consider buoyancy effect.

b) Compare Pile foundation and well foundation with both merits and demerits.

(15+05=20 marks)

4. Calculate unfactored vertical load (V), longitudinal moment (ML) & transverse moment (MT) at the base of pile cap using the following design parameters.

a) Pier size = 3x3m.
b) Height of the pier = 8.0m
c) Dimension of the rectangular pier cap is 10mx3.5mx1.5m. 1.5m is the depth.
d) Height of the bearing + pedestal = 500mm.
e) Depth of the superstructure = 3.0m
f) Super structure Dead load = 490.0t
g) Super imposed dead Load = 95.0t
h) Live Load = 100.0t
i) Braking Force = 15.0t
j) Centrifugal Force = 10 t
k) Vertical Wind load on super structure = 45.0t
l) Transverse Wind Load on superstructure = 25.0t
m) Longitudinal wind load on pier cap = 2.0t
n) Transverse wind load on pier cap = 0.50t
o) Longitudinal wind load on pier over ground level = 3.50t
p) Transverse wind load on pier over ground level = 1.50t
q) Height of Earth over Foundation = 0.50m

(20 marks)

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BACHELOR OF ENGINEERING (CIVIL ENGINEERING) FIFTH YEAR, SECOND SEMESTER EXAMINATION – 2024

SUBJECT : BRIDGE ENGINEERING

Time : Three hours for Full Marks – 100 (50 marks for PART – II)

PART – II.

Use Separate Answer Script for each part (*Assume any data,if reuired, reasonably)*

Answer any three from 1 to 4 --- 4 x 3

1. What are the Advantages & Disadvantages of a Precast Concrete Girder Bridge compared to a Cast-in-situ Girder.

2. Discuss on design criteria of a bridge superstructure with steel girders & concrete deck Without Shear Connectors and With Shear Connectors.

3. Name the different 'Loss in Pre-stress' in pre-stress bridge girder. What are the time dependent losses?

4. Name the different types of Bearings used in bridges and discuss on their nature of transferring forces.

Answer any two from 5 to 7 --- 7 x 2

5. Calculate 'Effective Width' of deck slab to act as flange of Exterior & Interior long girder for the data as given below

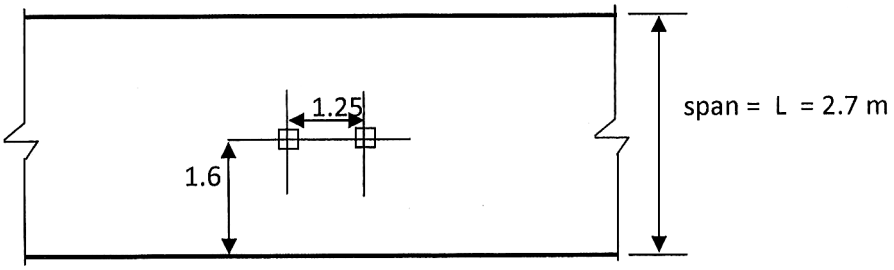
a) Bridge Span = 12 m., Girders are symmetrically placed
b) Overall width of deck slab = 13.5 m
c) Nos. of Long girder = 3,

Thickness of girder web = 300 mm, e) Spacing between long girders = 5 m

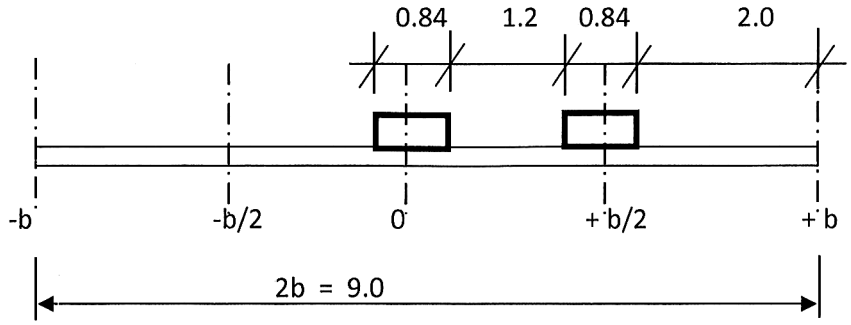
6. Design for a interior slab panel of size 3.2 m x 4.0 m for a wheel load of 17 T of contact area 350mm (shorter) x 840 mm (longer) using Pigeaud's method. Design for moment due to wheel load only. Write the procedure of finding coefficients m1 & m2 and use m1 & m2 = 0.2 & 0.15 respectively for this problem. Thk. of wearing course = 75 mm. Use poisson's ratio = 0.2

7. Calculate Design BM in Tm/m for one way simply supported slab for two nos. wheel load as per data below-

wheel loads = 15 T each, each contact area = 0.25 m x 0.25 m



8. Prepare the table of "Equivalent Loads at Standard Reference Stations" as per simplified Morice & Little method , for the deck & loading system as shown below – Consider the loading for a **Tracked Vehicle.** (width of each track =0.84 m, all dimensions are in Metre) ---- 9



9. Calculate 'Design Bending Moments & Shear Forces' in the Long Girders of a concrete bridge due to **two trains** of vehicular load as shown in sketch below having the following parameters: - **Use Courbon's method.** --- 15

a) Simply Supported Span, ie., Centre to centre of bearings in long. direction = 30 m.
b) All Long Girders are of same moment of inertia and girders are symmetrically placed.
c) Consider impact factor = 25%.,
d) Wheel Loads are half of Axle Load.
e) Axle Loads of **one train** of vehicle are shown in Figure -1 below-

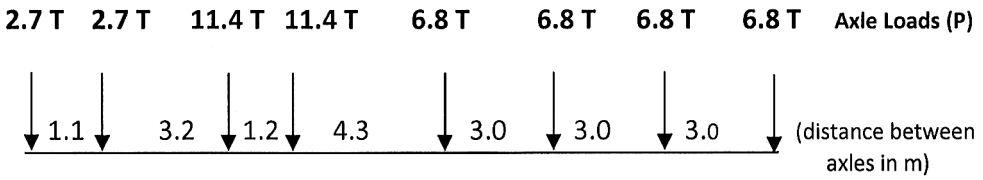
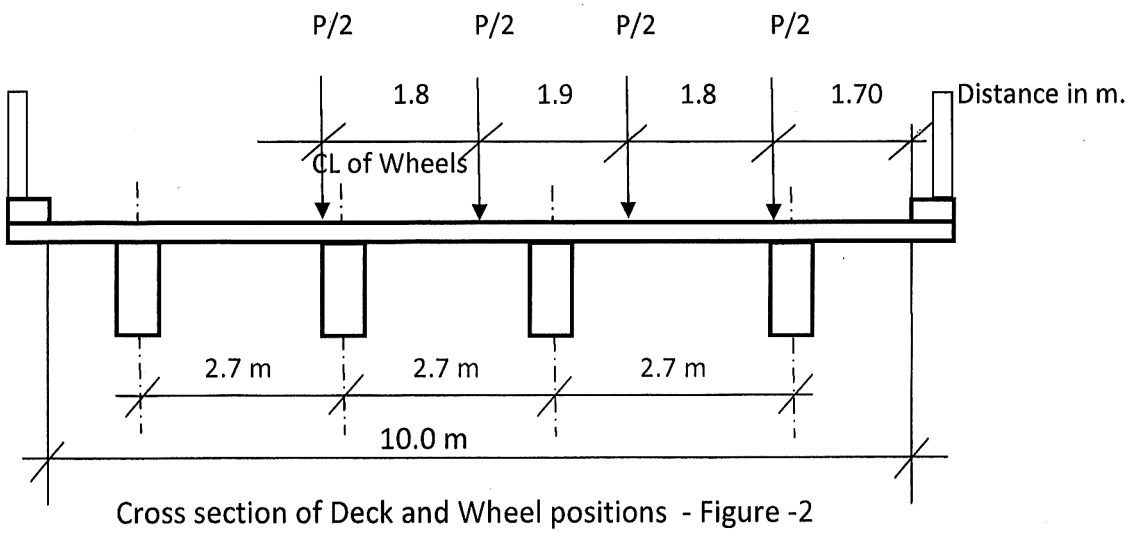


Figure - 1



Cross section of Deck and Wheel positions - Figure -2