Ref No. – Ex/CE/5/T/506A/2023

BACHELOR OF ENGINEERING (CIVIL ENGINEERING) 5th YEAR 2nd SEM. EXAMINATION 2023

BRIDGE ENGINEERING

Time : Three hours Full Marks : 100

(50 Marks for each Part)

Use a separate Answer-Script for each part

Part-I

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

1. A three-lane bridge is to be constructed on a sandy soil with a simply supported PSC span of 40m between c/c of the foundation/pier. The pier of the bridge shall rest on pile foundation of 9 nos. with symmetric configuration i.e. 3x3 matrix. The diameter of the circular bored cast-in-situ pile is 1.2m 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 1.0m. Dimensions of the substructure shall be as under:
   a) Diameter of the RCC Pier = 3.0m.
   b) Height of the pier = 10.0m
   c) Dimension of the rectangular pier cap is 8mx3mx1.5m.
   d) Height of the bearing+pedestal = 500mm.
   e) Depth of the superstructure = 2.0m
   f) Dead Load + SIDL of superstructure = 1200 ton.
   g) Braking force along longitudinal direction = 20.0t.
   h) Centrifugal force = 15.0t.
   i) Consider a shift of 150mm.
   j) Unit weight of RCC = 2.5t/m^3.
   k) Unit weight of the soil = 2.0t/m^3.

   Derive the maximum and minimum pile reaction. Consider a shift of 150mm in pier position along Longitudinal direction.

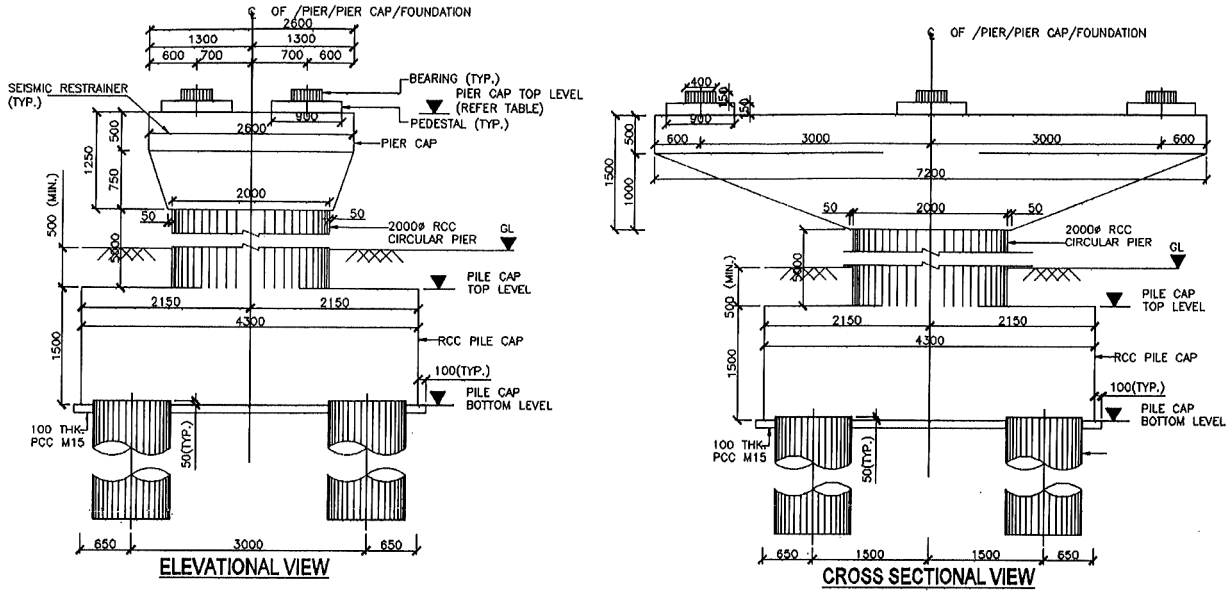
   (20 marks)

2. Calculate the foundation pressures at the base of the circular well with the following particulars:
   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 = 975.0t;
   f) Weight of pier = 185.0t;
   g) Weight of well = 1050.0t;
   h) Soil around the well is mixed type having C=0.25kg/cm^3; φ=32 degrees; Υ(dry)=1750kg/m3.
   i) Permissible bearing capacity of soil is 48 tonnes/m^2. FOS is 1.6 for seismic case and 2.0 for non-seismic case.
   j) Do not consider buoyancy effect.

   (20 marks)

3. Calculate unfactored vertical load (V), longitudinal moment (ML) & transverse moment (MT) at the base of pier & pile cap according to the figure 4a & 4b & unfactored load data given below.

[Turn over

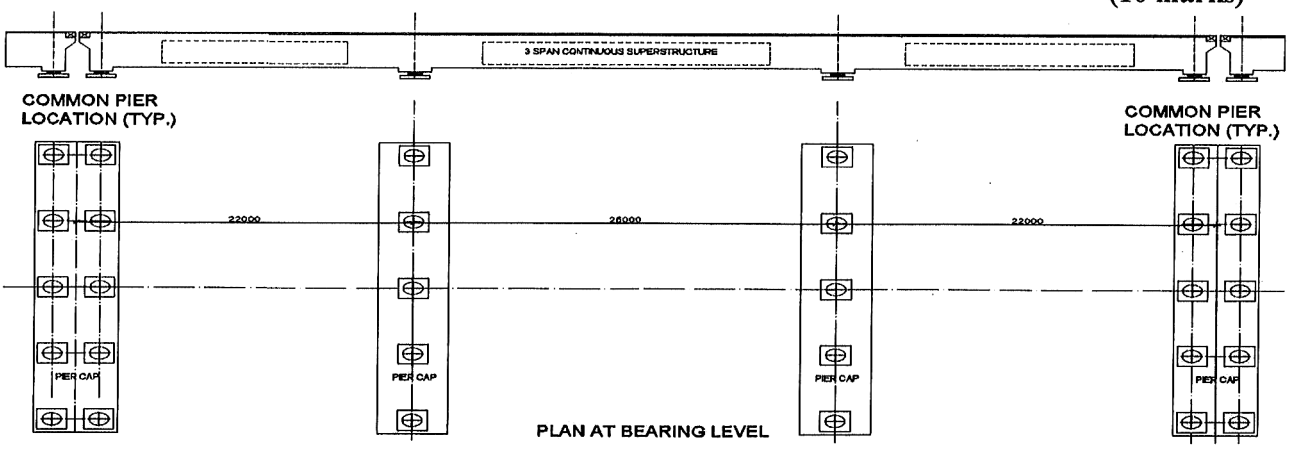


a) Super structure Dead load = 490.0t
b) Super imposed dead Load = 95.0t
c) Live Load = 100.0t
d) Braking Force = 15.0t
e) Centrifugal Force = 10 t
f) Vertical Wind load on super structure = 45.0t
g) Transverse Wind Load on superstructure = 25.0t
h) Longitudinal wind load on pier cap = 2.0t
i) Transverse wind load on pier cap = 0.50t
j) Longitudinal wind load on pier over ground level = 3.50t
k) Transverse wind load on pier over ground level = 1.50t
l) Height of Earth over Foundation = 0.50m

(20 marks)

4. Government has decided to construct a flyover in Howrah near Santragachhi locality to provide signal free movement. Designer has proposed 3-span continuous superstructure for the flyover. A typical arrangement of the superstructure is shown in the figure below. Propose a suitable bearing configuration (Fix, Free, longitudinally guided and transversely guided) for the superstructure in order to avoid development of internal stresses due to creep, shrinkage and thermal loads.

(10 marks)



Ref. No. : Ex/CE/5/T/506A/2023

BACHELOR OF ENGINEERING (CIVIL ENGINEERING) FIFTH YEAR, SECOND SEMESTER EXAMINATION – 2023

BRIDGE ENGINEERING
(Part – II)

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

Use separate Answer Script for each part
(Assume any data reasonably, if required,)

Answer any five from 1 to 6 ---------- **4 x 5**

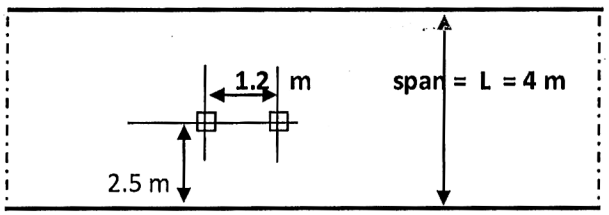
1. Name the different types of bridges. Give an example of Cantilever Bridge?
2. Name the different types of Bearings used in bridges and discuss on their nature of transferring forces.
3. What is the basic principal of Pre-stress concrete? What is the advantage of prestressing in different stage ?
4. Name the different 'Loss in Pre-stress' in pre-stress bridge girder. What are the time dependent losses?
5. What is a Composite Girder ? Name the primary element to cause composite action.
6. Name two types of Expansion Joint used in bridge deck. What are the basic difference among a cantilever beam, a Bracket & Articulation.

Answer any three from 7 to 10 ---------- **6 x 3**

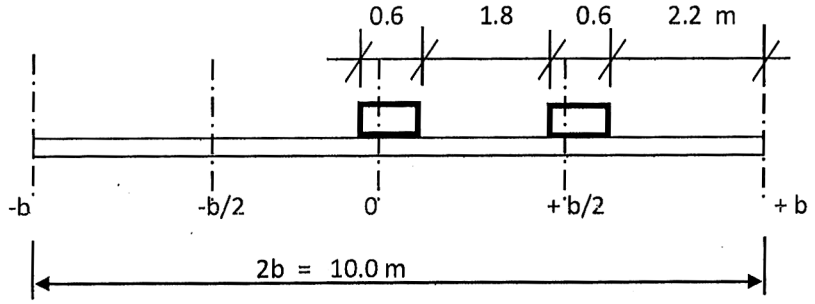
7. Find Design Moment (for LL) for a 200 mm thk interior slab panel of size 3.5 m x 4.5 m for a wheel load of 20 T of contact area 350mm(along shorter) x 850 mm (along longer) using Pigeaud's method. Write the procedure of finding Pigeaud's coefficients m1 & m2 and use m1 & m2 = 0.22 & 0.14 respectively
   i) Thk. of wearing course = 75 mm.
   ii) Use poisson's ratio = 0.17

8. Calculate design BM (for wheel load only) in Tm/m for one way simply supported slab as per data below-

wheel load (each of two loads) = 15 T shown thus □ , contact area of each wheel = 0.25m x 0.25m



9. Prepare the table of "Equivalent Loads at Standard Reference Stations" as per simplified Morice & Little method , for the deck & loading system as shown below , (loaded area are shown thus▭) –



10. 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,
d) Thickness of girder web = 300 mm, e) Spacing between long girders = 5 m

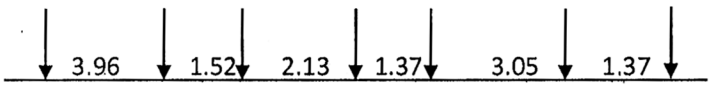
11. Calculate 'Design BM' due to vehicular load only as given below for Exterior Long Girder of a concrete bridge having the following parameters: - **Use Courbon' method**. ------ 12

a) Centre to centre of bearings (span) for the simply supported long girders = 30 m.
b) Overall width (incl. crash barrier) of deck slab 11 m, c) Thickness of crash barrier = 500 mm

c) Nos. of Long girder = 4 symmetrically placed, d) Spacing between long girders = 2.85 m

e) Min. clear distance of any wheel from crash barrier = 1.2 m & wheel to wheel distance of any axle = 1.9 m(c/c)

f) Vehicular Axle Load **8 T** **12 T** **12 T** **17 T** **17 T** **17 T** **17 T**



(axle distance in m)