(4 Hours) Marks: **80**

Note-
1. Question No. 1 is **compulsory**. Attempt **any three** out of remaining five questions.
2. Figures to the right indicate full marks.
3. Assume additional data if needed but justify the same.
4. Use of relevant IS codes **is permitted.**

Q.1 Design a post tensioned prestressed concrete slab bridge deck for a national highway crossing to suit the following data- 32

i) Live load = IRC class AA tracked vehicle
ii) Clear span = 10 m
iii) Width of bearing =400 mm
iv) Clear width of roadway = 7.5 m
v) Footpath 1m on either side
vi) Kerbs = 600 mm wide
vii) Thickness of wearing coat = 80 mm
viii) Type of structure = class 1 type.

Materials M -40 grade concrete and 7mm diameter high tensile wires with an ultimate tensile strength of 1500 N/mm^2 housed in cables with 12 wires and anchored by Freyssinet anchorages of 150 mm diameter. For supplementary reinforcement, adopt Fe 415 grade HYSD bars. Compressive stress at transfer, f_{ci} =35 N/mm^2. Loss ratio =0.8. 32
The permissible compressive stresses in concrete at transfer and working loads are f_{ct} = 15 N/mm^2, f_{cw} = 12 N/mm^2, $f_{tt} = f_{tw} = 0$

OR

A cellular multicelled prestressed concrete box girder deck is to be designed for a National Highway crossing. The proposed bridge deck is made up of two continuous spans each of 50 m. The road width is 7.5 m with foot paths 1.25 m on each side. The box girder is proposed to have 4 cells 2 m wide by 2 m deep and should support IRC Class AA tracked vehicle loading. Design the cellular bridge deck adopting M-6O Grade concrete, Fe-415 HYSD bars and high-tensile steel strands of 15.2 mm diameter conforming to the relevant Indian standards.

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Q.2 (a) A 2-span continuous prestressed concrete beam ABC (AB=BC= 15 m) has a uniform rectangular cross section 250 mm x 600 mm. A cable carrying an effective prestressing force of 500 KN is parallel to the axis of the beam and located at an eccentricity 200 mm. 12

i) Determine the secondary and resultant moment developed at the mid support section B.

ii) Calculate the resultant stresses developed at the top & bottom of the beam at B if the beam supports an imposed load of 2.4 KN/m.

iii) Also locate the resultant line of thrust through beam ABC.

(b) State Guyon's theorem of linear transformation of cable and its practical applications. 4

Q.3 (a) A reinforced concrete dome of 30 m base diameter and a rise of 3.75 m is to be designed for a prestressed concrete cylindrical tank. The shell dome is to be provided with a prestressed concrete ring beam. Design the dome and the ring beam for superimposed load of 1.5 KN/m^2. The 5 mm diameter high tensile wires, initially stressed to 1000 N/mm^2 are available for prestressing ring beam. 8

The loss ratio is 0.75.

The permissible compressive stress in concrete is 14 MPa at transfer

Diameter at base = 30 m; Radius of shell dome R =32 m

Thickness of shell = 75mm

Semi central angle, $\alpha = 28^0 4'$.

(b) The deck slab of a road bridge of span 10 m is to be designed as a one way prestressed concrete slab with parallel post tensioned cables in each of which the force at transfer is 480 KN. If the deck slab is required to support a uniformly distributed live load of 24 KN/m^2, with compressive & tensile stress in concrete at any stage not to exceed 15 N/mm^2 and zero N/mm^2respectively, design the suitable thickness of the slab and also calculate the maximum horizontal spacing of the cables and their position at the mid span section. Assume the loss ratio as 0.80. 8

Q.4 (a) A concrete cylindrical shell roof covering an area of 10 m x 30 m is to designed with prestressed edge beams using following data - 12

Radius of the shell = 7.5 m, semi-central angle =40^0, chord width = 10 m, span of shell = 30 m, thickness of shell = 75 mm, width of edge beam = 150 mm, depth of edge beam = 1.5 m.

(b) Explain the slab action & plate action with reference to folded plates subjected to transverse loading. Give neat sketches. 4

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Q.5 (a) A composite T-beam is made up of a pre-tensioned rib 120 mm wide and 240 mm deep, and a cast in situ slab 450 mm wide and 50 mm thick having a modulus of elasticity of 28 KN/mm^2. 8

If the differential shrinkage is 100x10^{-6} units, determine the shrinkage stresses developed in the precast and cast in situ units. Also draw the stress distribution diagram.

(b) A dam trapezoidal in section with vertical water faced is 1m wide at the top 3m wide at the base and 10 m in height. It is subjected to water pressure for its full height on the vertical face Determine the magnitude and the line of action of the prestressing force required given that- 8

i) The loss in stress = 12% and

ii) Permissible stress in concrete = 5 /mm^2.

Assume specific gravity of masonry = 2.3 There should be no tension in the dam both stages i.e. When it is full or empty. Check the stresses at toe and heel for tank empty and tank full conditions.

Q,6 (a) A cylindrical prestressed concrete water tank of internal diameter 30 m is required to store water over a depth of 7.5 m. The permissible compressive working stress in concrete at transfer is 13 N/mm^2 and the minimum compressive stress under working pressure is 1N/mm^2. The loss ratio is 0.75. Wires of 5mm diameter of initial stress of 1000 N/mm^2 are available for circumferential winding and Freyssinet cables made up of 12 wires of 8 mm diameter stressed to 1200 N/mm^2 are to be used for vertical prestressing. Design the tank walls assuming the base as fixed. The cube strength of concrete is 40 N/mm^2. 12

(b) Write a short note on maintenance of prestressed concrete structures. 4