(Duration:3Hours) MaximumMarks: 80

Note: 1) Q1 is compulsory. Attempt any three out of remaining five questions.
2) Use of IS 1343:2012 is permitted in the examination.
3) Assume suitable data if required and mention it clearly.
4) Support answers and solutions with suitable sketches.

Q1. A] Develop the expression for ultimate shear strength/resistance of prestressed concrete section when un-cracked in flexure. **[05]**

B] Develop the expression for minimum sectional modulus of prestressed concrete section to be provided such that it is safe in limit state of serviceability cracking. **[05]**

C] Why flanged sections are preferred in prestressed concrete construction? Also explain why efficiency of rectangular section is always $33\frac{1}{3}\%$? **[05]**

D] What are the various reasons for failure of prestressed element in flexure? **[05]**

Q2. A] A beam 500mm wide and 750mm deep is prestressed by a parabolic cable having an eccentricity of 200mm below neutral axis at the centre of the span and 200mm above neutral axis at the end supports. The effective PF in the cable is 1600kN. If the simply supported beam of span 8m carries a total uniformly distributed load of 80kN/m which includes the self weight, evaluate the extreme fibre stresses at service stage at the mid span section using internal resistance couple method. **[05]**

B] A concrete beam of rectangular cross section 200mm wide and 600mm deep is prestressed by a cable located at an eccentricity of 100mm at mid span and zero at supports. The span is 10m and live load is 4kN/m. Suggest suitable cable profile and effective force necessary for zero principal tensile stresses throughout the span. **[05]**

C] A post tensioned beam of rectangular cross section 200mm wide and 400mm deep is 10m long and carries an applied load of 8kN/m uniformly distributed on the beam. The effective prestressing force in the cable is 500kN. The cable is parabolic with zero eccentricity at the ends and maximum of 140mm at the centre of the span. Determine the spacing of 2mmϕ vertical prestressing wires initially stressed to 1200MPa, to eliminate principal tensile stresses completely at support. **[05]**

D] A concrete beam of rectangular cross section 500mmx1000mm deep is continuous over two spans AB=BC=10m. The beam is prestressed by a cable carrying 4000kN. The cable is parabolic and concentric at supports A, B and C and has eccentricity 100mm at the centre of spans AB and BC. If the beam supports a live load of 20kN/m though out the spans A-B-C, Replace cable by equivalent load and estimate the extreme fibre stresses develop at central support section due to combined effect of prestressing force, dead load and imposed load. Take Υ_c=24 kN/m^3. **[05]**

Q3. A] The end block of a post tensioned prestressed concrete bridge girder is of rectangular section 450mmx1350mm. Three anchorages spaced at 450mm c/c are of 225mmx225mm and used to transfer PF of 4000kN each. Verify safety of end block against punching of plates also design anchorage zone reinforcement. Use M50 concrete with f_{ci}=30MPa and Fe415 steel. **[10]**

B] A continuous beam A-B-C has spans AB=10m and BC=10m. It is prestressed by a single cable which has eccentricity of 200mm below neutral axis at supports A and C, and 200mm towards top at central support B. Cable is linear between AB and BC. Draw pressure line along the span due to prestressing force alone mentioning ordinate at supports A, B, C and at mid of spans AB & BC. Take PF=1250kN. **[10]**

Q4. A symmetric I-section with flange width and depth 200mm and 60mm respectively, has thickness of web 75mm and over all depth as 400mm is prestressed by a PF 980kN with f_i=1200MPa. Span is 4m. Parabolic cable coincides with the junction of web and flange at mid span and it is at 200mm from soffit of beam at support. Take E_C=38kN/mm^2 and E_s=200kN/mm^2

i. Determine initial deflection. Is it with in permissible limit? If not, make suitable change in PF to restrict the deflection.

ii. If M50 grade concrete is used calculate deflection at when beam supports a total uniformly distributed load which is 1.5times of load corresponding to first flexural tensile crack appears at mid span soffit. **[20]**

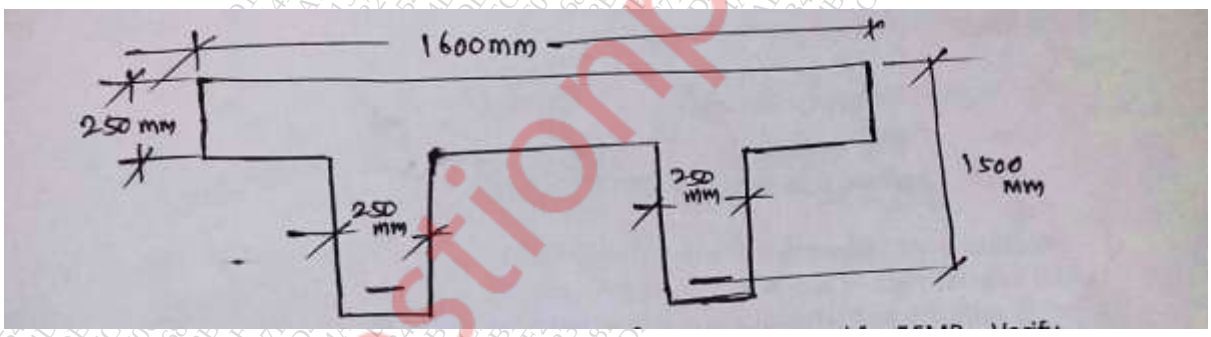
Q5. A] A 800mm wide 250mm deep simply supported bridge deck slab panel is designed as type 1 element has following specifications:

Span 10m, f_{ct}=f_{cw} =16.5MPa, f_i=950MPa, live load on slab 10kNm^2, loss of stress in steel 18%. Design prestressing force and eccentricity corresponding to limit state of serviceability cracking. Also provide cables in safe cable zone. Determine the number of 3mmϕ wires in each cable if slab is prestressed by 4 cables at a spacing 200mm c/c across the section. **[15]**

B] A cantilever prestressed concrete beam of 8m span has rectangular section 300mmx600mm. It is prestressed by two cables of area 600mm^2 each, initially stressed to 1200N/mm^2. The cables are located at a constant eccentricity of 200mm above neutral axis throughout the span. Beam has to carry 30kN/m ultimate uniformly distributed load (inclusive of self weight). Verify its safety in limit state of strength shear when uncracked in flexure. Take f_{ck}=40MPa. **[05]**

Q6.A] A post tensioned prestressed concrete beam of 16m span is subjected to initial stress due to 1458kN prestressing force. Cable profile is parabolic with eccentricity of 520mm at mid span and zero at supports. Jacking is done from both ends. Estimate loss of stresses in steel for the following specifications.
C/s Area= 2.42x10^{5}mm^2, I=5.3x10^{10}mm^4, A_{pst}= 1386mm^2,
ε_{ca}=45x10^{-6}, ε_{cd}=240x10^{-6},
Creep co-efficient ϕ=1.4, Anchorage slip=2.5mm at each end,
μ= 0.25, wobble correction factor K=0.0015/m
f_s=1052MPa at transfer, f_p=1600MPa, E_s= 2.1x10^5 MPa, E_c=0.382x10^{5}MPa,
Calculate net loss of stresses and strain in steel accounting effect of stresses in steel due to bending caused by a load of 30kN/m (inclusive of self weight). **[15]**

B] A post tensioned prestressed concrete girder is a double T-section as under.



Total area of prestressing steel is 4700mm^2, f_p=1600MPa and f_{ck}=56MPa. Verify its safety in limit state of strength flexure if ultimate moment acting at the section is 5000kN-m (inclusive of self weight). **[05]**

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