Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER 2012

Subject code: 712007N **Date: 16-01-2013**

Subject Name: Prestressed Concrete (Elective)

Time: 02.30 pm – 05.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** State advantages & disadvantages of continuous psc members. **07**

(b) State the equations which control the limits of the permissible tendon zone in a psc prismatic member with a constant prestressing force. **07**

Q.2 **(a)** Enlist different types of losses in prestress in pre-tensioning & post-tensioning & its performance on prestress concrete. Explain Hoyer's effect & define transmission length. **07**

(b) Design a pre-tensioned flexural beam using following data. **07**

Superimposed load = 5kn/m

Effective span = 8.0 m

Compressive strength at transfer =30 MPa

f_{ck} = 45 MPa

Loss in prestress = 15 %

f_y = 1500 MPa

OR

(b) A psc beam of c/s200*300mm deep is used over an effective span of 6m to support an imposed load of3kn/m. The density of concrete is 2500kn/m^3. At the center of span section of the beam, find the magnitude of (1) the concentric prestressing force necessary for zero fiber stress at the soffit, when the beam is fully loaded. (2) The eccentric prestressing force located at 100mm from the bottom of the beam which would nullify the bottom fiber stresses due to loading. **07**

Q.3 **(a)** A post-tensioned cable of a beam 10m long is initially tensioned to a stress of 1000N/mm^2 at one end. If the tendons are curved so that the slope is 1 in 15 at each end with an area of 600mm^2,calculate the loss of prestress due to friction, given the following data: **07**

Coefficient of friction between duct & cable =0.55

Friction coefficient for wave effect =0.0015/m

During anchoring, if there is a slip of 3mm at the jacking end; calculate the final force in the cable & the %age loss of prestress due to friction & slip.

(b) A pretension beam 250mm wide and 300mm deep is prestressed by 12 wires each of 7mm diameter initially stressed to1200N/mm^2 with their centroid located 100mm from the soffit. Estimate the final %age loss due to elastic deformation,creep,shrinkage & relaxation using IS:1343-1980 code and the following data: **07**

Relaxation of steel stress =90N/mm^2

Es =210Kn/mm^2,Ec =35Kn/mm^2,

Creep coefficient (φ) =1.6
Residual shrinkage strain =$3*10^{-4}$

OR

Q.3 **(a)** A concrete beam of rectangular section, 250 mm wide and 650 mm overall depth is subjected to a torque of 20kNm and a uniform prestressing force of 150 kN. Calculate the maximum principal tensile stress. Assuming 15 per cent loss of prestressing force necessary to limit the principal stress to 0.4 N/mm^2. **07**

(b) A concrete beam of rectangular section, 300mm wide and 800mm deep is subjected to a twisting moment of 30kN m and a prestressing force of 150kN acting at an eccentricity of 220mm. Calculate the maximum principal tensile stress. If the beam is subjected to a bending moment of 100kN m in addition to the twisting moment, Calculate the maximum principal tensile stress. **07**

Q.4 **(a)** A pretensioned T-section has a flange 1200 mm wide and 150 mm thick. The width and depth of the rib are 300 and 1500 mm respectively. The high tensile steel has an area of 4700 mm^2 and is located at an effective depth of 1600 mm. if the characteristic cube strength of the concrete and the tensile strength of steel are 40 and 1600 N/mm^2 respectively. Calculate the flexural strength of T- section. **07**

(b) A post tensioned bridge girder with unbounded tendons is of box section of overall dimensions 1200mm wide by 1800 mm deep, with wall thickness of 150 mm. The high- tensile steel has an area of 4000 mm^2 and is located at an effective depth of 1600mm. The effective prestress in steel after all losses is 1000N/mm^2 and effective span of the girder is 24m. If f_{ck} =40N/mm^2 and f_p = 1600N/mm^2, estimate the ultimate flexural strength of the section. **07**

OR

Q.4 **(a)** A prestressed beam of rectangular section, 100 mm wide and 200 mm deep, has a straight duct 25mm by 40mm with its centre located at 50mm from the soffit of the beam which is prestressed by 12 wires of 7mm dia stressed to 600N/mm^2. The beam supports an imposed load of 4KN/m over a span of 6 m. E_c = 38kN/mm^2. Estimate the central deflection of the beam under the action of prestress, self weight and live load,(a) based on net section (beam ungrouted) and (b) based on transformed section (beam grouted) **07**

Q.4 **(b)** A prestressed concrete beam 120mm wide and 300 mm deep is used to support a uniformly distributed live load of 3kN/m over an effective span of 6 m. The beam is prestressed by a straight cable carrying an effective prestressing force of 180kN at a constant eccentricity of 50mm. Given E_c- = 38kN/mm^2, the modulus of rupture= 5N/mm^2, area of the cable = 200mm^2 and modular ratio = 6, estimate the deflection of the beam at the following stages (a) working load **07**
(b) cracking load
(c) 1.5 times the cracking load.

Q.5 **(a)** A composite bridge deck of span 12m is made up of a precast prestress symmetrical I-section and in situ cast slab. The precast I-beams are spaced at 750 mm centers and the top slab of the in situ concrete is 120mm thick. The cross- sectional details of the precast I-beams are as follows: **07**
Thickness of top and bottom flanges = 110mm
Width of top and bottom flanges = 200 mm

Thickness of web = 75 mm
Depth of precast I-beam = 500 mm
Self weight of precast concrete = 24kN/m^3
Self weight of cast in situ concrete = 23.5 kN/m^3
The prestressed beam is unpropped during the placing of in- situ concrete
The form work load is estimated to be 0.2kN/m of the span.
If the compressive prestress in the beams is 15N/mm^2 at the bottom and zero at the top , calculate the maximum stresses developed in the precast and in situ cast concrete under an imposed load of 5kN/m^2, assuming,

(a) The modular ratio of cast in situ to precast concrete to be 1.0 and
(b) The modular ratio of cast in situ to precast concrete to be 0.8

(b) A composite T-section girder consists of a pre-tensioned rectangular beam 120mm wide & 240mm deep, with an in-situ cast slab, 360mm wide & 60mm deep, laid over the beam. A pretension beam contains eight wires of 5mm diameter, located 30mm from the soffit. The tensile strength of the high tensile steel is 1600N/mm^2 & the cube strength of concrete in top slab is 20N/mm^2. **07**

(a)Estimate the flexural strength of the composite section,
(b)Calculate the ultimate shear which will cause separation of the two parts of the girder if,
(1)The surface contact is roughened to withstand a shear stress of 1N/mm^2 and(2) 10mm mild steel stirrups(two-legged) are placed at 100mm centres.Ultimate shear stress across the stirrups =190N/mm^2.

OR

Q.5 **(a)** A straight, pre-cast, pre-tensioned beam of I-section is to be designed to support a uniformly distributed imposed load of 8kN/m in addition to the self weight of the member. The effective span of simply supported beam is to be 9m.Using concrete grade of M-45 with permissible comp. strength in concrete at transfer and working loads as 15N/mm2, & 5mm diameter high-tensile steel wires of U.T.S.=1600N/mm^2,which are initially stressed to 1200N/mm^2, design the cross-sections of the girder as a pretensioned beam class 1 member without allowing any tension under working loads. Assume total losses of prestress as 20 %.Sketch the cross-section of the girder at the center of span showing the arrangements of wires. Load factors of 1.5 for dead load & 2.5 for live load may be assumed. **07**

(b) A post-tensioned, prestressed concrete girder having a span of 40m between bearings is required for an aircraft hangar. The live load on the girder is 5kN/m. The specified 28-day cube strength is 50N/mm^2.The cube strength of concrete at transfer is 30N/mm^2.Permissible stresses should confirm to the provisions of IS:1343.The prestress to be provided by seven wire 15mm strand cables, each tensioned to1200kN,housed in cable ducts of64mm.Ultimate tensile strength of each cable =1750KN.Loss ratio =0.80. **07**

The design has to comply with the various limit states of deflection, cracking and collapse. Design the following particulars:
(a)the cross-section of the girder,
(b)cable profile, and
(c) end block.

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