B.Arch. Part-III 6th Semester Examination, 2007

Structural Engg.-II

(CE-601A)

Time : 3 hours **Full Marks : 100**

Use separate answerscript for each half.
Answer SIX questions, taking THREE from each half.
The questions are of equal value.
Two marks are reserved for neatness in each half.
Assume any data suitably, if required.

FIRST HALF

1. Design a rivetted truss member with 2-unequal angle sections, connected to either side of a 10 mm gusset plate at the ends. The member is subjected to axial compressive force of 150 kN due to Dead Load and Live Load and 100 kN tensile force due to Dead Load and Wind Load. Take effective length of the member as 2.6 m. Use 16 mm nominal diameter p.d.s. rivets. The available single angle sections are :

Sections	Area (mm^2)	C_{XX} (mm)	C_{YY} (mm)	I_{XX} (mm^4)	I_{YY} (mm^4)
1-ISA 90608	1137	29.6	14.8	91.5×10^4	32.4×10^4
1-ISA 100658	1257	32.8	15.5	125.9×10^4	41.9×10^4
1-ISA 100758	1336	31.0	18.0	131.6×10^4	63.3×10^4
1-ISA 125758	1538	41.5	16.8	245.5×10^4	67.2×10^4

Given, $r_{XX} = \sqrt{\frac{I_{XX}}{A}}$; $r_{YY} = \sqrt{\frac{I_{YY}}{A}}$,

$$\sigma_{cr} = 0.6 \frac{\sigma_{cc} \cdot \sigma_y}{\left[\sigma_{cc}^{1.4} + \sigma_Y^{1.4}\right]^{1/1.4}} , \quad \sigma_{cc} = \frac{\pi^2 E}{\lambda^2} .$$

2. a) Design a welded connection for the truss member of (Q.1), with side and end fillet welds. Given, permissible shear stress = 108 MPa.

   b) Design a rivetted connection for the truss member of (Q.1). What is the rivet value in this case?

   c) Given, yield stress (characteristic) of structural steel subjected to axial tension is 250 MPa and Permissible tensile strength as 150 MPa. What is the value of factor of safety in this case?

3. A simply supported beam of 8 m effective span consists of ISMB 500 together with two flange plates 220 x 15 mm. Determine the maximum uniformly distributed load, it can carry, if the compression flange is torsionally restrained at the ends only. The beam is not restrained against lateral bending.

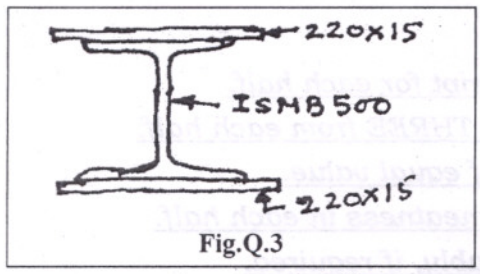

Fig.Q.3

Given,

i) Properties of ISMB 500 :
$a = 110.74\ cm^2$, $b = 180\ mm$, $t_f = 17.2\ mm$, $t_w = 10.2\ mm$, $I_{XX} = 45218.3\ cm^4$, $I_{YY} = 1369.8\ cm^4$, $r_X = 20.21\ cm$, $r_Y = 3.52\ cm$.

ii) $\sigma_{cr} = k_1 (X + k_2 Y) \cdot \frac{C_2}{C_1}$; $X = Y \sqrt{1 + \frac{1}{20}\left(\frac{lT}{r_Y D}\right)^2}$ MPa ;

$Y = \frac{26.5 \times 10^5}{(l/r_Y)^2}$ MPa ; $\sigma_{bc} = 0.66 \frac{\sigma_{cr} \cdot \sigma_Y}{\left[\sigma_{cr}^{1.4} + \sigma_Y^{1.4}\right]^{1/1.4}}$

Check for deflection is not required.

4. A column of effective length 7 m consists of two channels, placed back-to-back, carrying an axial load of 800 kN. (Ref Fig.Q.4). Column section is 2-ISMC-350, separated by a distance of 220 mm. Design a suitable SINGLE LACING system for the column.

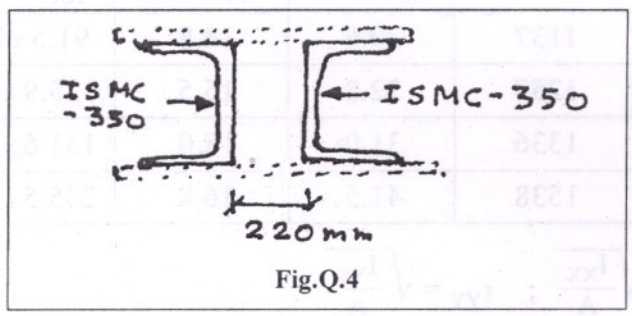

Fig.Q.4

Given,

i) Properties of 1-ISMC-350 :
$a = 54.4\ cm^2$, $b = 100\ mm$, $t_f = 13.5\ mm$, $C_Y = 2.44\ cm$, $I_{XX} = 10{,}000\ cm^4$, $I_{YY} = 434\ cm^4$, $r_{XX} = 13.6\ cm$, $r_{YY} = 2.82\ cm$, $g = 60\ cm$.

ii) $(I_{YY})_{gross} > (I_{XX})_{gross}$.

5. Design (and draw) a gussetted column base to carry an axial load of 2000 kN. The column consists of one ISHB-300 and two cover plates 300 x 25 mm one in each flange. Take permissible bearing pressure of concrete pedestal as 6.25 MPa. Use 16 mm gusset plate, ISA 150 x 115 x 12 angles.
Design of connections is not required.

SECOND HALF

6. A R.C.C. beam 250mm wide and 600mm overall deep has 4 bars of 20mm diameter as tension reinforcement, the centre of bar being 50mm from the bottom of the beam. Determine moment of resistance of the beam. Maximum allowable compressive stress in concrete is 5.27 N/mm^2, tensile stress of steel 126.5 N/mm^2 and modular ratio =18.

7. A doubly reinforced beam of 250mm wide and 560mm deep up to the centre of tensile reinforcement is subjected to a bending moment of 85 kN-m. Calculate the area of tensile steel and compressive steel. Maximum allowable compressive stress in concrete is 5 N/mm^2, tensile stress of steel 140 N/mm^2 and modular ratio =19(tension), mc=1.5m (compression) and cover to compression steel is 40 mm.

8. (a) What is a column? Explain the difference between short column and long column. What will be the effective length of the column when: (i) Both end fixed (ii) Both end hinged?

(b) Find the safe load that a 400mm x 400 mm R. C. Column 2.4m long can carry when it is reinforced with 8 Nos. 20mm diameter bars. The compressive stress in concrete in axial tension is 5 N/mm^2, tensile stress of steel 130 N/mm^2.

9. (a) Discuss the function of a foundation and various types of foundation.

(b) Design a footing for a square column 400 mm x 400 mm carrying an axial load of 1000 kN. Take compressive stress in concrete = 7 N/mm^2, tensile stress of steel 130 N/mm^2, m=13.33 and bearing capacity of soil =200 k N/mm^2.

10. (a)Define one way slab. What are the minimum reinforcement requirements for deformed bars and mild steel?

(b) Design a floor slab 3 m x 6.5 m simply supported over a clear span of 3m. The slab is to be finished with 25mm thick cement concrete flooring. Super imposed load is 3.m kN/m^2 adopt M-20 grade concrete and mild steel reinforcement Fe250 i.e. maximum allowable compressive stress in concrete is 7 N/mm^2, tensile stress of steel 140 N/mm^2 and modular ratio =13.

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