B.E. (Civil Engg.), Part -III, 6* Semester Final Examinations, 2010
Sub: Design of Steel Structures
(CE-601)

Time: 3 hours **Full Marks: 70**

Use separate answer script for each half
Answer any Six questions, taking Three from each half
All questions are of equal value. Two marks are reservedfor neatness in each half
Assume any data reasonably, if required All the notations used have their usual meanings.
Consider E250 (Fe410) steel conforming to IS 2062. E=2Q0 GPa.

First Half

1. Design a simply supported welded plate girder of span 25 m, subjected to factored dead load (inclusive of self-weight) of 20 kN/m and imposed load of 25 kN/m. Assume the top flange of the plate girder is restrained laterally and prevented from rotating. Check for shear buckling and design of stiffeners and weld are not required.

2. A simply supported welded plate girder of span 30 m is made with flange plate 500 mm x 40 mm and web plate of 1000 mm x 10 mm. The girder carries a factored udl of 60 kN/m, inclusive of self-weight. Design the end-bearing stiffener. Check for buckling, bearing and torsional restraint.

   Given,/, >0.34a$_5$£>^{3}/$_c$y, whereof =30/(*Z,/r$_y$) ; For (kUr)-10, 20, /$_{c(}$/=227 and 224 MPa, respectively.

3. A gantry girder of simply supported span 7.5 m, is composed of 1SMB 600 @1.23 kN/m and ISMC 300 @ 0.363 kN/m. Check the adequacy of the section in overall buckling for the following data: i) Static wheel load=130 kN, ii) Wheel base =2.0 m, iii) Height of rail =150 mm,

   iv) ***XLT*** =0.75, v) Zp* of overall section =4279.79 cm^3, vi) Z„=719.5 cm^3 for top flange of overall section, viiJZ^- 3310 cm^3 of overall section, viii) ***Z***^- 532.4 cm^3 for top flange of overall section, ix)LateraI surge=7.5 kN per wheel.

   Consider the section to be plastic. Assume 2 kN/m for weight of rail and gantry girder. Calculations and checks for shear capacity, longitudinal drag force, reduction of moment capacity due to shear force, local capacity, weld design, web buckling, web bearing, deflection and fatigue are not required.

4. A simply supported beam of span 5.5 m is carrying a D.L. of 17 kN/m (inclusive of self-weight) and L.L. of 25 kN/m. Check whether ISMB 450 @ 724 N/m [^=1533.36 cm^3, Z«=1350 cm^3, t_w=9.4 mm, tf= 17.4 mm, bf=150 mm, ri=15 mm] is adequate for the beam in i) flexure, ii) flexural shear, iii) shear buckling, iv) deflection v) web buckling. Consider the section as Plastic. Given, Allowable deflection= L/300. Consider stiffbearing length as 75 mm. f^ = 110 MPa.

5. Check the adequacy of the bracket connection subjected to torsion and shear due to an eccentric vertical factored load of 200 kN at an eccentricity of 250 mm from centroid of connection. Use ten numbers of M20 bolts of grade 4.6, equally divided into two rows. Pitch and guage of the bolts are 75 mm and 150 mm, respectively. Capacity of M20 bolt in single shear and bearing is 45.23 kN and 66.64 kN, respectively.

Second Half

6. A Laced column of effective length 9 m, consists of 2-ISMC 300, placed toe-to-toe at a spacing of 170 mm. The column carries a factored axial force of 800 kN. The properties of 1 -ISMC 300 are a=45.64 cm^2, bf =90 mm, tf=13.6 mm, t*=7.6 mm, Cyy=2.36 mm, 1^=6362.6 cm^4, I„= 310.8 cm^4, r_n= 11.81 cm, ^=2.61 cm, g=50 mm. Design a suitable single lacing system for the above column. Check whether the lacing bars are safe from axial tension and compression. Design of tie plate is not required.

7. A Crane column of length 8 m, made with ISWB 400 @ 66.7 kg/m (a= 85.01 cm^2, bf=200 mm, trl3.0 mm, tw=8.6 mm, I„=23426.7 cm^4, I_w=1388.0 cm^4, r„=16.60 cm, ryy= 4.04 cm, Zpz=1290.19 cm^3) is subjected to maximum factored bending moment of 70 kN-m and factored axial force of 150 kN. Check whether the section is adequate with the following data: i) ***XLT*** =0-87, X_{LT} =0.75,***Cm'Cmy'CmLT*** "0.8,^ = $\frac{kl}{r\pi}$ \| ~^r • ») The section is plastic. iii) ki_z = 11.5m, ki_y = 6m, iv) There is no reduction due to shear force, v) *Mfidz* =1.1 U/dz (1 - *n*) <, *Ufa* vi) a_2 = 2, vii) $/_w$ = ***XLT/***, r_mo . viii) *fa* = 150.54 MPa for major axis buckling and *fa* = 102.8 MPa for minor axis buckling, ix) Interaction factors K_z-\XK$_y$ ~\2,Kif =0.95, x) Interaction formulae: $\frac{P}{}$ + $\frac{OAKyC\wedge My}{Mdz}$ + K * C » " M * <;i "and ***_P_^KyC$_{my}$My*** +***KL$_t$M$_{_il}$*** check for shear is not

8. Design base plate and welds of a gusseted column base subjected to a factored moment of 40 kN-m and a factored axial load of 350 kN. The column size is ISWB 400 @ 66.7 kg/m (b(=200 mm). Use 12 mm gussets and 16 mm diameter anchor bolt. Concrete in foundation is of M25 grade.

9. Calculate the safe tensile load carried by a single angle discontinuous bolted rafter made with ISA 90x60x6 (a=8.65 cm^2, C_a=2.87 cm, iC„=1.39 cm, I_a= 70.6 cm^4, 1^=25.2 cm^4, r_z=2.86 cm, ryy=1.71 cm, g= 50 mm, ri= 7.5 nun), with longer leg connected a 8 mm thick gusset plate. Consider 4 nos. M 16 bolts, placed in a single row. Edge distance and pitch are 30 mm and 50 mm, respectively. Given,

T* =\$A_n f_y$ ***I***V3r„o + 0.9***AJ$_m$ ly$_{mX}$]*** or [0.9^ ***l&y$_{mX}$*** +0.9^/„ ***ty$_{m0}$].***

10. Calculate size of site fillet weld required to transmit the factored load in each bracket as shown in Fig. Q.10. $/_w$ =***f$_u$l4^7$_{mm}$***. The column section is ISWB 400 (b|=200 mm, t(= 13.0 mm).

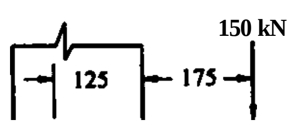

Fig. Q.10

All dimensions are in mm