

**DESIGN OF STEEL STRUCTURES
(CIV3201)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

USE OF IS CODE IS ALLOWED IN THE EXAMINATION HALL

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) When the load line coincides with the c.g. of the bolt group, then the bolts are subjected to
 - (a) only shear
 - (b) only tension
 - (c) only bending
 - (d) both shear and tension
- (ii) A fillet weld of size 8 mm is used in a steel joint. The effective throat thickness of the weld is:
 - (a) 4.8 mm
 - (b) 5.6 mm
 - (c) 5.2 mm
 - (d) 8.0 mm
- (iii) The design strength of a tension member is given by
 - (a) rupture at a critical section
 - (b) yielding of gross area
 - (c) block shear of end region of the above
 - (d) All of the above
- (iv) The slenderness ratio of lacing flats is limited to
 - (a) 350
 - (b) 180
 - (c) 145
 - (d) 200
- (v) Minimum number of battens required in a built up column are
 - (a) 2
 - (b) 3
 - (c) 4
 - (d) 6
- (vi) In rolled steel beams, shear force is mostly resisted by
 - (a) Web only
 - (b) Flanges only
 - (c) Web and flanges together
 - (d) Upper flange only
- (vii) The ratio of plastic section modulus to elastic section modulus
 - (a) is equal to 1
 - (b) is always less than 1
 - (c) is always greater than 1
 - (d) can be less than 1
- (viii) The angle of dispersion of a concentrated load on the flange to the web plate of a steel beam is
 - (a) 90° with the horizontal
 - (b) 60° with the vertical
 - (c) 45° with the horizontal
 - (d) 30° with the vertical

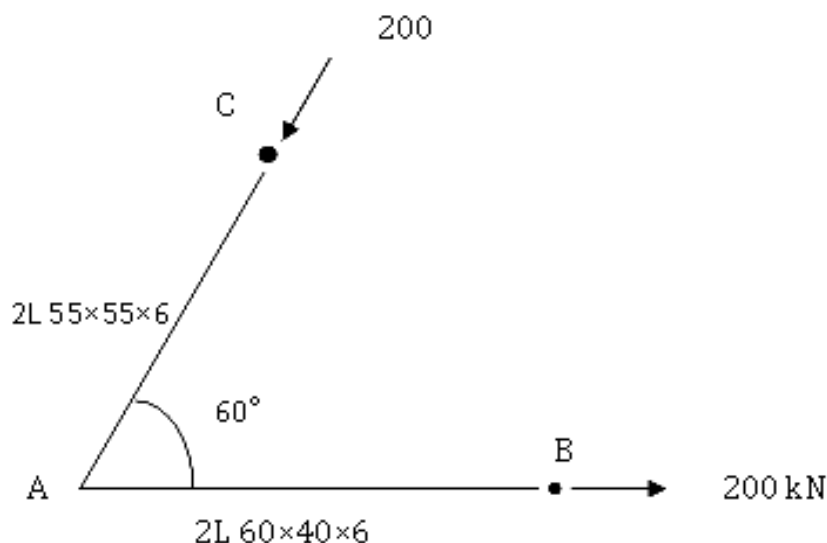
- (ix) For gantry girders carrying electrically operated overhead travelling cranes, the lateral force are increased by
 (a) 25% of maximum static wheel load
 (b) 10% of maximum static wheel load
 (c) 10% of weight of the crab and weight lifted by the crane
 (d) 5% of the weight of the crab and weight lifted by the crane
- (x) Which of the following loads are to be considered in designing a gantry girder in an industrial building?
 (i) gravity loads (ii) Lateral loads (iii) Longitudinal loads (iv) Wind loads
 Select the correct answer using the codes given below:
 (a) (i) and (ii) (b) (i), (ii) and (iii)
 (c) (i) and (iii) (d) (ii), (iii) and (iv)

Fill in the blanks with the correct word

- (xi) Proof stress for minimum bolt tension is given by _____ f_{ub} .
- (xii) The efficiency of welded joint is _____ than that of bolted/riveted joint.
- (xiii) The impact allowance for horizontal force transverse to the rail (surge load) for an EOT crane is _____.
- (xiv) The imperfection factor for welded steel section is _____.
- (xv) The maximum slenderness ratio of a compression member carrying both dead and superimposed load is _____.

Group - B

2. (a) Design a lap joint between two plates of width 100 mm and thickness 12 mm and 20 mm so as to transmit a factored load of 70 kN (tensile) using M16 bolts of grade 4.6 and grade 410 plates. [[CO1,CO2](Analyse/IOCQ)]
- (b) Design a bolted connection of a truss joint as shown in the figure using M16 black bolts of 4.6 grade and steel having $f_u = 410 \text{ N/mm}^2$. Use 10 mm thick gusset plate.

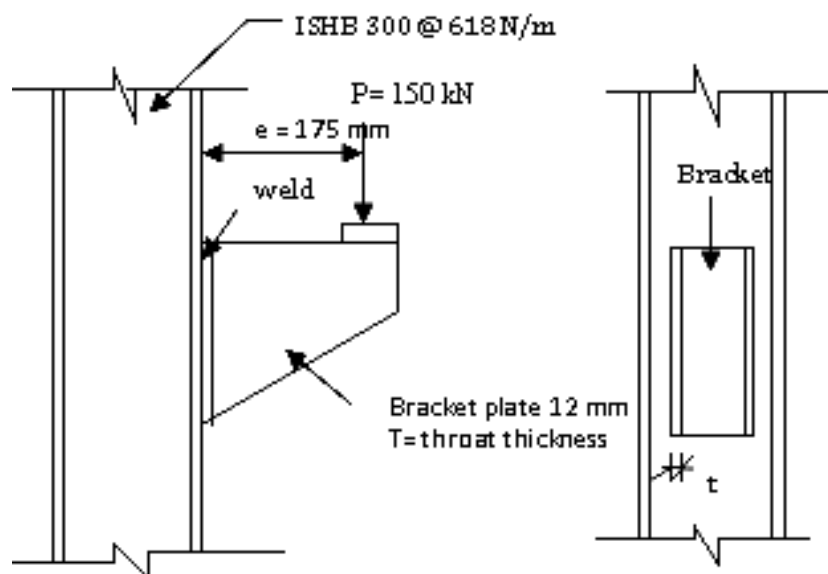


[[CO1,CO2](Analyse/IOCQ)]

5 + 7 = 12

3. Design a suitable fillet weld for the bracket as shown in the figure, if working load $P = 150$ kN and eccentricity $e = 175$ mm. Thickness of the bracket plate is 12 mm and the column used is ISHB 300@618N/m.

[[C01,C02](Create/HOCQ)]]



12

Group - C

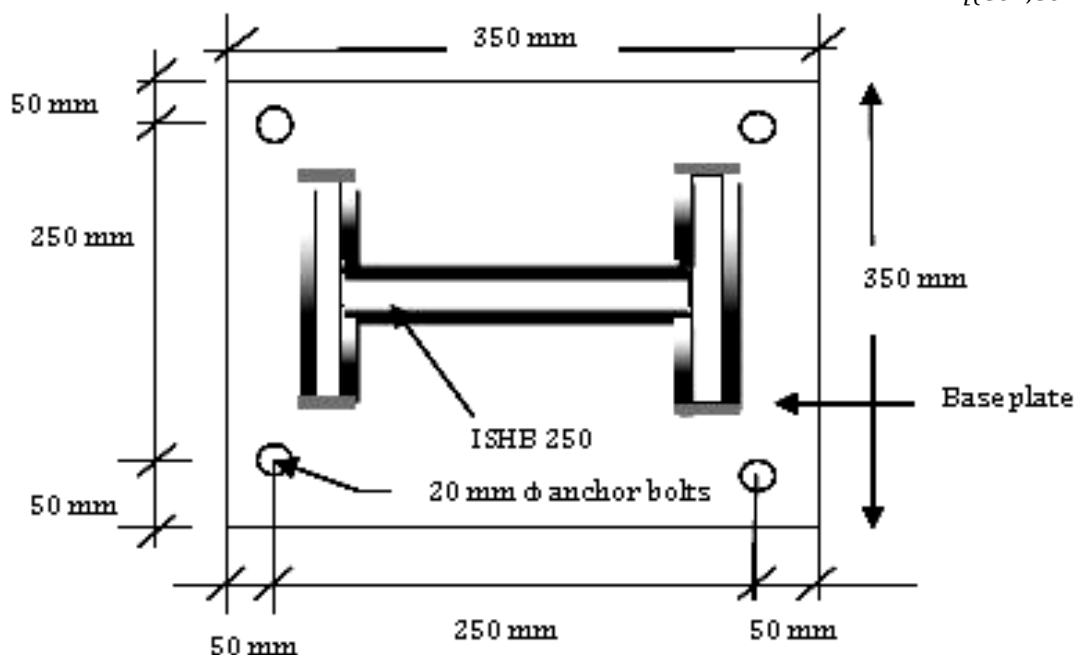
4. A tension member 3 m long carries a factored tensile load of 200 kN. Design a suitable single angle unequal section when connection is made with 20 mm diameter of grade 4.6. Assume longer leg to be connected with plate.

[[C01,C03](Create/HOCQ)]]

12

5. Design the base plate for a column made of ISHB 250 @ 51.10 kg/m to carry a compressive load of 780 kN. The grade of concrete used is M 20. Assume Fe 410 grade steel.

[[C01,C03](Create/HOCQ)]]



12

Group - D

6. Check the adequacy of a beam, without lateral restraint along its span is fabricated using ISMB 600 @1202.71 N/m. Effective span 4m, maximum bending moment 550 kNm and maximum shear force 200 kN. Consider $f_y = 250 \text{ N/mm}^2$, $f_u = 410 \text{ N/mm}^2$, $E = 2 \times 10^5 \text{ N/mm}^2$.
[[CO4,CO5](Analyse/IOCQ)]
12
7. Determine the moment and shear capacities of a plate girder having 560 mm × 50 mm flange plate at top, 1800 mm × 12 mm web plate and 560 mm × 50 mm flange plate at the bottom. Consider $f_y = 250 \text{ N/mm}^2$, $f_u = 410 \text{ N/mm}^2$. Calculate buckling resistance of web also.
[[CO5](Create/HOCQ)]
12

Group - E

8. A hand operated travelling crane on simply supported gantry girder have the following data:
 Span of gantry girder = 5.0m, Span of crane girder = 15m, Crane capacity = 200kN, Self weight of crane girder = 200 kN, Self weight of trolley = 30 kN, Minimum hook approach = 1.0 m, Distance between wheels = 3.5 m, Self weight of rails = 0.3 kN/m
 Determine maximum moment and shear forces due to vertical and horizontal loads and check whether ISWB 500 with ISMC 300 on compression flange is adequate to carry moment, shear force, provide buckling resistance and limiting deflection.
[[CO5](Analyse/IOCQ)]
12
9. A gantry column, 13 m long, is fixed at base and hinged at top. The length of the crane leg is 10 m and that for roof leg is 3 m. The axial compression on roof leg is 50 kN and that on crane leg is 900 kN. The roof is fabricated using 2-ISMB 500 @ 86.9 kg/m and the crane leg uses ISMB 500. Check the safety of the gantry column against the axial compression only. Consider $f_y = 250 \text{ N/mm}^2$, $f_u = 410 \text{ N/mm}^2$, $E = 2 \times 10^5 \text{ N/mm}^2$.
[[CO5](Evaluate/HOCQ)]
12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	0	37.5	62.5