DESIGN OF STEEL STRUCTURES
(CIVL 3201)

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 & STEEL TABLE IS ALLOWED IN THE EXAMINATION HALL

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Load on which connection is not eccentric for
(a) lap joint (b) single-cover butt joint
(c) double-cover butt joint (d) any of the above

(ii) The maximum pitch of the bolts for a compression member should not exceed
(a) 2.5 times diameter of the bolt (b) 2.5 times diameter of the hole
(c) 12t or 200 mm whichever is less (d) 16t or 200 mm whichever is less

(iii) The maximum slenderness ratio for a tension member in which reversal of direct stress due to loads other than wind or seismic forces occurs is
(a) 350 (b) 180 (c) 300 (d) 400

(iv) Angle of inclination of lacing bar with longitudinal axis of column preferably in between
(a) 10° to 30° (b) 30° to 40°
(c) 40° to 70° (d) 90°

(v) The effective length of battened column is increased by
(a) 5% (b) 10% (c) 15% (d) 20%

(vi) For simply supported beam, the maximum permitted deflection is
(a) 1/300 of the span (b) 1/350 of the span
(c) 1/375 of the span (d) 1/400 of the span

(vii) What value of impact factor should be considered for design of gantry girder?
(a) 1.45 (b) 1.35 (c) 1.25 (d) 1.15

(viii) Stiffeners are used in a plate girder
(a) To reduce the compressive stress (b) To reduce the shear stress
(c) To reduce the bearing stress (d) To avoid buckling of web plate

(ix) Gantry girders are usually designed as
(a) Laterally supported beams
(b) Laterally unsupported beams
(c) For combination of vertical loads and either of the lateral and longitudinal force l
(d) both (b) and (c)

(x) In a workshop, usually a crane girder spans between
(a) Adjacent columns along the length of the shop
(b) Opposite column across the shop
(c) Bottom chord members of an adjacent roof trusses
(d) Insufficient data

Fill in the blanks with the correct word

(xi) For block shear failure of a tension member, the failure occurs along a path through the connection involving tension on one plane and shear on the other _____ plane.

(xii) A steel plate is 25 cm wide and 12 mm thick. If the diameter of the bolt hole is 20 mm, the net sectional area of the plate is _____.

(xiii) A beam section is classed as low shear case when the factored shear force is less than _____.

(xiv) The minimum value of shear lag parameter (β) to calculate the rupture strength of single angles is _____.

(xv) The buckling class of built-up members is _____.

Group - B

2. A bracket plate bolted to a vertical column is loaded as shown in the Fig. 1. If M20 bolts of grade 4.6 are used, determine the maximum value of factored load P which can be carried safely. *[(CO1)(Evaluate/HOCQ)]*

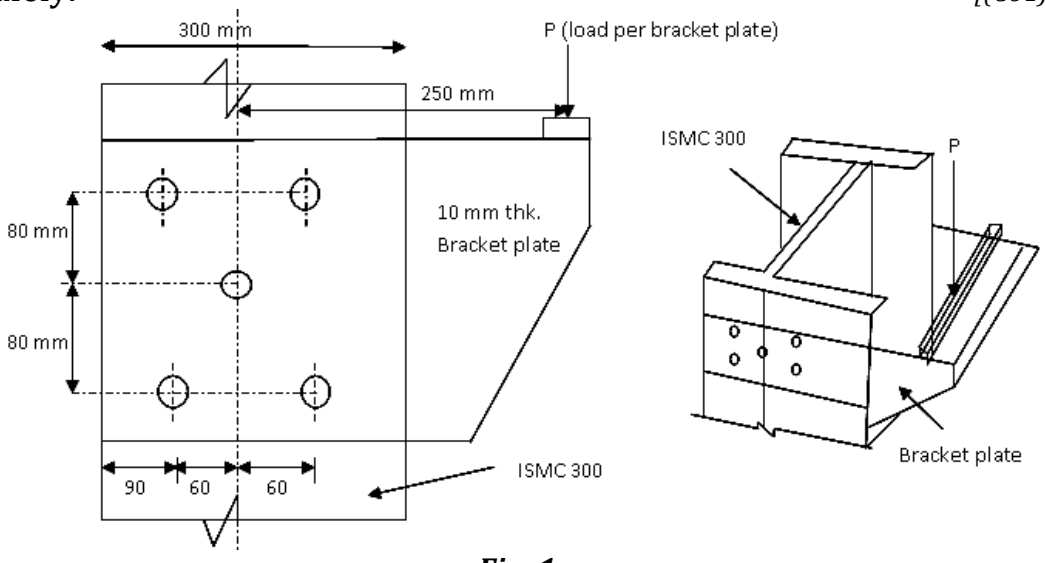

Fig. 1

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3. A tie member of a truss consisting of an angle section of ISA 70 × 70 × 6 mm of Fe 410 grade, is welded to a 8 mm gusset plate. Design a weld to transmit a load equal to the full strength of member. Assume shop welding. *[(CO1)(Create/HOCQ)]*

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Group - C

4. Determine the design tensile strength of the plate 120 mm × 8 mm connected to a 12 mm thick gusset plate with bolt holes as shown in the Fig. 2. The yield strength and ultimate strength of the steel used are 250 MPa and 400 MPa. The diameter of the bolts used is 16 mm. *[(CO2)(Analyse/HOCQ)]*

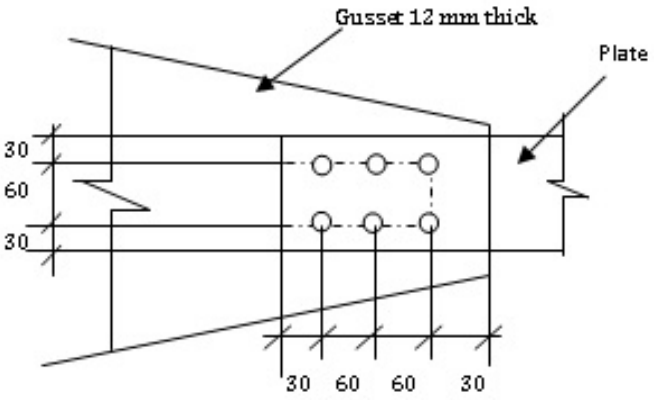

Fig. 2

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5. Design a laced column 9 m long to carry a factored axial load of 1200 kN. The column is fixed at both the ends. Provide single lacing system with bolted connection. The column consists of two channels placed back to back. *[(CO2,CO4)(Create/HOCQ)]*

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Group - D

6. Design a laterally unrestrained beam to carry a uniformly distributed load of 50 kN/m. The beam is unsupported for a length of 1.5 m and is simply placed on longitudinal beams at its ends. Consider f_y = 250 N/mm^2, f_u = 410 N/mm^2, E = 2 × 10^5 N/mm^2. Choose a section of ISMB 175 @ 0.19 kN/m. *[(CO3,CO5)(Analyse/IOCQ)]*

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7. Determine the moment and shear capacities of a plate girder having 550 mm × 40 mm flange plate at top, 1000 mm × 12 mm web plate and 400 mm × 40 mm flange plate at the bottom. Consider f_y = 250 N/mm^2, f_u = 410 N/mm^2, E = 2 × 10^5 N/mm^2. *[(CO5)(Create/HOCQ)]*

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Group - E

8. The following data refers to a gantry girder of an electrically operated crane of capacity 200 kN
Span of gantry girder=6.0 m

Span of crane girder=18 m
Crane capacity=200 kN
Self weight of crane girder=180 kN
Self weight of trolley=75 kN
Minimum hook approach=1.0 m
Distance between wheels=3.5 m
Self weight of rails=0.3 kN/m
Check whether ISMB 600 with ISMC 300 on compression flange is adequate to (a) carry moment (b) carry shear force (c) provide buckling resistance and (d) limiting deflection. Consider f_y = 250 N/mm^2, f_u = 410 N/mm^2, E = 2 × 10^5 N/mm^2. *[(CO6)(Analyse/IOCQ)]*

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9. A welded gantry girder, without lateral restraint along its span, to be used in an industrial building carrying an overhead travelling crane is fabricated using ISMB 550 @103.7kg/m with a channel ISMC 300 @ 35.8 kg/m at the top. Centre-to-centre distance between columns (i.e. span of gantry girder) =7 m. Calculate the moment capacity and buckling resistance of the gantry girder. Consider f_y = 250 N/mm^2, f_u = 410 N/mm^2, E = 2 × 10^5 N/mm^2. *[(CO6)(Evaluate/HOCQ)]*

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	0	25	75