11819

3 Hours / 100 Marks   Seat No.

Instructions :   (1)   All Questions are *compulsory.*

(2)   Answer each next main Question on a new page.

(3)   Illustrate your answers with neat sketches wherever necessary.

(4)   Figures to the right indicate full marks.

(5)   Assume suitable data, if necessary.

(6)   Use of Non-programmable Electronic Pocket Calculator is permissible.

(7)   Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

(8)   Use of IS:800-2007 is permitted.

Marks

1.   Attempt any FIVE of the following :   **20**

(a)   Enlist two grades of structural steel along with their characteristic strength used for steel structures.

(b)   Draw neat sketch of unequal angle section and channel section with their geometric properties.

(c)   Enlist various modes of failures of riveted joint and explain shear failure of rivet with neat sketch.

(d)   Define the term efficiency of a joint.

(e)   State minimum and maximum size of fillet weld as per I.S. Specification.

(f)   Draw the neat sketch of slab base & concrete block. Also write the formula of calculating thickness of base plate, with meaning of each term used.

(g)   Define lacing of column. How much load is taken by lacings as per IS 800. Draw neat sketch of single & double lacing.

2. Attempt any TWO of the following : 16

(a) Design the lap joint connecting the plates of cross section 100 mm × 16 mm thk. and 100 mm × 10 mm thk. so as to transmit a factored load of 110 kN using single row of 16 mm PDS rivets.

$\lambda pf = 300$ MPa and $\lambda vf = 100$ MPa

(b) Find out the number of PDF rivets required to connect a tension member in a roof truss to a gusset plate 8 mm thk. Tension member is a flat of size 120 mm × 8 mm and is subjected to a pull of 90 kN. For PDF river $\lambda pf = 270$ MPa, $\lambda vf = 90$ MPa.

(c) A single bolted double cover butt joint is used to connect two plates of 10 mm thk., the thickness of cover plates on both side is 6 mm. Use 20 mm PDS rivets, design the joint and also calculate the efficiency of joint.

3. Attempt any TWO of the following : 16

(a) (i) Draw a neat sketch showing the size and thickness of throat of a Fillet weld. Write the relation between them.

(ii) Define effective length of weld. State the formula to calculate required length of weld (lw).

(b) Calculate the length of fillet weld required to connect a tie bar 80 mm × 8 mm to a 10 mm thk. gusset plate. Joint has to be designed for full strength of tie bar and welding on all three sides.

Takes $\gamma_{mw} = 1.50$, $F_u = 410$ MPa, $F_y = 250$ MPa

(c) The tension member of a truss consist of 2 ISA 80 mm × 50 mm × 8 mm and is welded on either side of gusset plate by longer leg. The member is subjected to Factored tensile force of 275 kN. Design the fillet weld connection. Assume shop welding. Take $C_{XX} = 27.30$ mm.

4. Attempt any TWO of the following : 16

(a) Design a tie member of roots truss subjected to an axial service load of 150 kN. Use single equal angle connected by rivets of 16 mm diameter at ends. Refer table.

Available Section	Section Area (A) mm^2	Weight (kg/m)
ISA 80 × 80 × 8	1221	9.6
ISA 80 × 80 × 10	1505	11.8
ISA 90 × 90 × 8	1379	10.8

(b) A tension member consists of 2 ISA 100 mm × 100 mm × 10 mm connected back to back on the same side of gusset plate. Calculate its neat area if 20 mm diameter rivets are used. Also find the tensile strength of member.

(c) A single angle 100 mm × 75 mm × 10 mm is used as a tension member of a truss. The longer leg of angle is connected to the gusset plate with 4 bolts of 20 mm diameter in a single row. Determine the net effective area of the angle.

If the ends of angle are welded to gusset plate determine the net effective area of angle.

5. **Attempt any TWO of the following :** 16

(a) (i) Define slenderness ratio and radius of gyration. Why the minimum radius of gyration is to be considered ?

(ii) A single angle strut ISA 50 mm × 50 mm × 6 mm of a roof truss is 1.16 m long. It is connected by one rivet at each end. Determine the safe load carrying capacity of strut.

For ISA 50 mm × 50 mm × 6 mm, $A = 568$ mm^2, $I_{xx} = I_{yy} = 12.9 \times 10^4$ mm^4

$C_x = C_y = 14.5$ mm $\gamma_{mn} = 0.96$ cm.

Table No. 1

Values of permissible stress in axial compression

λ	50	60	70	80	90	100	110	120	130	140
σ_{ac} N/mm^2	132	122	112	101	90	80	72	64	57	51

(b) A discontinuous strut 1.75 m long (effective) consist of two equal angles ISA 50 mm × 50 mm × 6 mm. It is connected on the same side of gusset plate by two rivets at each angle at both ends. Calculate the safe compressive load which this strut can carry if yield stress of steel is 250 MPa.

(For properties refer above question)

Table No. 1

Values of permissible stress in axial compression

λ	50	60	70	80	90	100	110	120	130	140
σ_{ac} N/mm^2	132	122	112	101	90	80	72	64	57	51

(c) Calculate the value of the least radius of gyration for a compound column consisting of ISHB250 with two cover plates of 300 mm × 20 mm on each Flange

Take For ISHB250 :

$l = 6971$ mm^2, $t_f = 9.7$ mm, $b = 250$ mm

$I_X = 7983.9 \times 10^4$ mm^4, $I_Y = 2011.7 \times 10^4$ mm^4

6. **Attempt any TWO of the following :** 16

   (a)   (i)   With the neat sketch explain the term Lag Angle.

          (ii)   State the effective length of following compression members.

               (1)   Single angle discontinuous one rivet or bolt at each end.

               (2)   Single or double angle continuous two or more rivet bolt or welding at each end.

               (3)   Column effectively held in position at both ends restrained against rotation at one end.

               (4)   Column effectively held in position and restrained against rotation at one end but not held in position or restrained against rotation at the other end.

   (b)   (i)   Two plates 180 mm × 20 mm are connected by a lap joint using 6 bolts of 20 mm diameter as shown in fig. below. Determine the strength of a plate in tension. Take $F_Y = 250$ N/mm^2 and Fu = 410 N/mm^2.
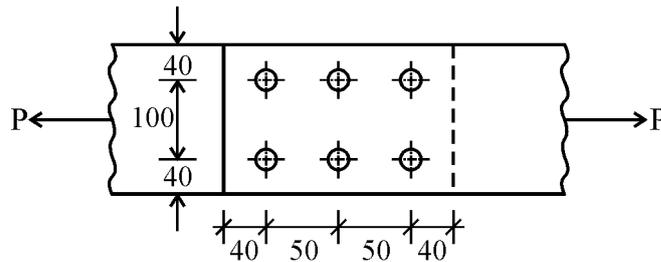
          (ii)   Draw a neat sketch of gusseted base showing top view, elevation and side view.

   (c)   Design a square slab base and concrete block for column section of SC 250 with two cover plates 300 mm × 25 mm carrying an axial load of 3000 kN. The SBC of soil is 300 kN/m^2 and grade of concrete is M-20. Draw neat sketch showing plan and elevation for designed slab base with suitable cleat angles.

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