17505

21819

4 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.

Marks

1. (A) Attempt any THREE : **3 × 4 = 12**

(a) State any six advantages and two disadvantages of use of steel as a construction material.

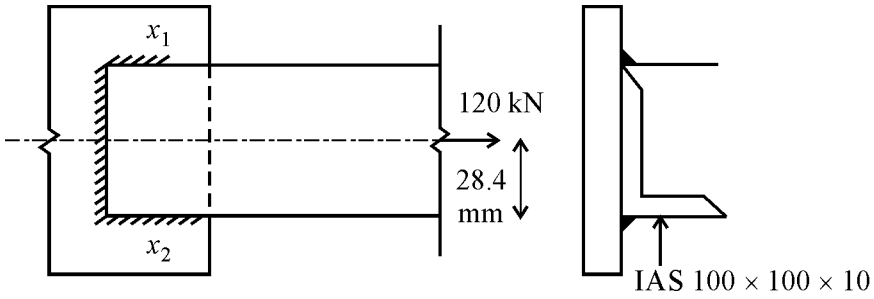
(b) Explain any two modes of failure of bolted joint along with drawing of respective.

(c) Draw plan, elevation and side view of a gusseted base showing all components.

(d) Draw neat sketches of Howe & North Light trusses. Mark panel, panel point, rafter and tie in any one truss.

(B) Attempt any ONE : **1 × 6 = 6**

(a) Calculate the length of fillet weld required to connect an ISA 100 × 100 × 10 mm with gusset plate using 6 mm weld as shown in fig, The angle is subjected to factored axial load of 300 kN. $C_{xx} = C_{yy}$ for angle is 28.4 mm.



(b) Design a suitable ISLB section for simply supported beam of an effective span 5.0 m subjected to a udl of 30 kN/M exclusive self-weight over entire span. The beam is effectively restrained for a laterally buckling along it's span-check the section for shear and deflection. $E = 2 \times 10^5$ MPa. Refer table below for properties of rolled steel beam.

Designation	**Wt N/m**	**A mm^2**	**b mm**	**t_f mm**	**I_{xx} mm^4**	**Z_p mm^3**	**Z_{xx} mm^3**	**Root Radius r_1 mm**	**t_w**
ISLB 300	377	4808	150	9.4	7332×10^4	554.32×10^3	488.9×10^3	15.0	6.7
ISLB 325	431	5490	165	9.8	9874×10^4	687.76×10^3	607.7×10^3	16.0	7.0
ISLB 350	495	6301	165	11.4	13538.36×10^4	851.11×10^3	751.9×10^3	16.0	7.4

2. Attempt any TWO : **2 × 8 = 16**

(a) 12 mm thick plates are connected using double bolted lap joint using 16 mm diameter bolt of 4.6 grade at a pitch of 80 mm. Calculate strength and efficiency of joint.

(b) Draw sketches of three different modes of failure in case of members subjected to axial tension.

(c) A strut 2.4 m long of a roof truss consist of a single angle 90 × 90 × 6 mm. Calculate load carrying capacity if it is connected to 8 mm thick gusset plate by welding. Assume properties of ISA 90 × 90 × 6 mm, f_y = 250 N/mm^2, Area = 1047 mm^2, $C_{xx} = C_{yy}$ = 2.42 mm, $r_{xx} = r_{yy}$ = 27.7 mm, r_{vv} = 17.5 mm.

KL/V	80	90	100	110	120	130
f_{cd} (N/mm^2)	136	121	107	94.6	83.7	74.4

3. Attempt any FOUR : **4 × 4 = 16**

(a) State the different types of limit state and describe any one of them.

(b) Draw and labelled any four forms of built up compression member.

(c) Differentiate between laterally supported and unsupported beam with neat sketches.

(d) State the necessity of column bases. Also, state the function of cleat angle and anchor bolts in slab base.

(e) Write step wise procedure of Design of angle purlin.

P.T.O.

4. (A) Attempt any THREE : **4 × 3 = 12**

(a) Define :

(i) Importance factor

(ii) Zone factor

(iii) Response reduction factor

(iv) Fundamental natural period

(b) Calculate the strength of tie member composed of 2ISA 150 × 75 × 8 mm when they are placed back to back with their longer leg connected on the same side of the gusset plate by 20 mm diameter bolt. Tacking bolt have been used.

(c) An ISMB 450 is used as a simply supported beam of 4 m span which carry 20 kN/m load. Check the section for shear only.

(d) Write any four selection criteria of type of roof truss. Also, define the perm pitch and slope of roof truss.

(B) Attempt any ONE : **1 × 6 = 6**

(a) A hall of size 12 × 18 m is provided with link type trusses at 4 m c/c. Calculate panel point load in case of dead load and live load from following data :

(i) Unit weight of roofing = 150 N/m^2

(ii) Self wt. of purlin = 120 N/m^2

(iii) Weight of bracing = 100 N/m^2

(iv) Pitch = 1/5

(v) No. of panels = 6

(b) A column section HB 200 @ 373 N/m carries an axial service load of 2000 kN. Determine the area and thickness of slab base for the column. The grade of concrete is M10. Take width of flange = 200 mm.

5. Attempt any TWO : **2 × 8 = 16**

(a) An industrial building has trusses for 12 m span. Trusses are spaced at 3.5 m c/c and rise of truss is 3 m. Calculate panel point load in case of live load and wind load using following data :

(i) Coefficient of internal wind pressure = ± 0.2

(ii) Coefficient of external wind pressure = –0.7

(iii) Design wind pressure = 1200 N/m^2

(iv) No. of panels = 08

(b) Design a column section to support a service load of 1000 kN. The section consists of four equal angus. The overall dimensions of the section being 240 mm × 240 mm. The column has an effective length of 4 m. Use f_y 250 steel. Refer table :

Angle	Area	I_{xx} (mm)	C_{xx} (mm)
100 × 100 × 10	1903	177×10^4	28.4
110 × 110 × 8	1708	196×10^4	30
90 × 90 × 8	1379	104.2×10^4	25.1

(c) Design a tension member consisting of single unequal angle section to carry a tension load of 340 kN. Assume single row 20 mm bolted connection. The length of member is 2.4 m. Take Fe-410 MPa. $\alpha = 0.80$

Section Available	Area (mm^2)
ISA 100 × 75 × 8	1336
ISA 125 × 75 × 8	1538
ISA 150 × 75 × 8	1748

6. Attempt any FOUR : **4 × 4 = 16**

(a) State any four advantages and disadvantages of welded connections over bolted connections.

(b) State general requirements for lacing as per IS-800.

(c) State four classification of cross-section of beam based on moment-rotation behaviour as per IS 800-2007.

(d) Define Gusseted base. Also, draw it's neat labelled sketch showing details.

(e) State any eight types of trusses.

IS:800-2007 Equations (Formula Sheet)

$$V_{nsb} = \left(\frac{f_u}{\sqrt{3}}\right)(n_n A_{nb} + n_s A_{sb}) \;,\; V_{dsb} = \frac{V_{nsb}}{\gamma_{mb}} \;,\; V_{dpb} = \frac{V_{npb}}{\gamma_{mb}}$$

$$T_{dg} = \frac{A_g f_y}{\gamma_{m0}} \;,\; T_{dn} = \frac{0.9 f_u A_n}{\gamma_{m1}} \qquad V_{npb} = 2.5 k_b d t f_u \qquad k_b = \left[\frac{e}{3d_o}, \frac{p}{3d_o} - 0.25, \frac{f_{ub}}{f_u}, 1.0\right]$$

$$f_{wd} = \frac{f_u}{\sqrt{3}\,\gamma_{mw}}$$

$$T_{dn} = \frac{0.9 A_{nc} f_u}{\gamma_{m1}} + \beta \frac{A_{go} f_y}{\gamma_{m0}} \quad \text{where } \beta = 1.4 - 0.076\,(w/t)\,(f_y/f_u)\,(b_s/L_c) \quad \leq (f_u \gamma_{mo}/f_y \gamma_{m1}) \times 0.9 \quad \geq 0.7$$

$$T_{dn} = \frac{\alpha A_n f_u}{\gamma_{m1}} \;,\; T_{db1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}} \;,\; T_{db2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$$

$$P_d = A_e f_{cd} \;,\; P_z = 0.6\, V_Z^{\,2} \;,\; V_z = V_b\, k_1\, k_2\, k_3$$

$$f_{cd} = \chi \frac{f_y}{\gamma_{m0}} \;,\; \chi = \frac{1}{\phi + \sqrt{\phi^2 - \lambda_e^2}} \;, \text{where } \phi = 0.5[1 + \alpha(\lambda_e - 0.2) + \lambda_e^2]$$

$$\lambda_e = \sqrt{k_1 + k_2 \lambda_w^2 + k_3 \lambda_\varphi^2}$$

where $\lambda_w = \dfrac{\left(\frac{l}{r_w}\right)}{\varepsilon\sqrt{\frac{\pi^2 E}{250}}}$ and $\lambda_\varphi = \dfrac{(b_1 + b_2)/2t}{\varepsilon\sqrt{\frac{\pi^2 E}{250}}}$

$$M_z = \frac{\beta_b \cdot Z_p \cdot f_y}{\gamma_{mo}} \qquad V_{dz} = \frac{f_y \times t_w \times h}{\gamma_{mo}\sqrt{3}}$$

$$t_s = \sqrt{[2.5w(a^2 - 0.3b^2)\gamma mo / fy]} \quad > t_f$$

Values of χ and fcd (N/mm^2) for different values of KL/r_{min} as per buckling curve 'c'

KL/r_{min}	10	20	30	40	50	60	70	80	90
χ	1.000	0.987	0.930	0.870	0.807	0.740	0.670	0.600	0.533
fcd	227	224	211	198	183	168	152	136	121

KL/r_{min}	100	110	120	130	140	150	160	170	180
χ	0.471	0.416	0.368	0.327	0.291	0.261	0.234	0.212	0.192
fcd	107	94.6	83.7	74.3	66.2	59.2	53.3	48.1	43.6