17505

11920
4 Hours / 100 Marks Seat No. | | | | | | | | |

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

(2) Answer each Section on same / separate answer sheet.

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

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

(5) Figures to the right indicate full marks.

(6) Assume suitable data, if necessary.

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

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

(9) Attach formulae sheet with question paper.

Marks

1. (A) Attempt any THREE of the following : 12

(a) Define dead, live, wind and snow load.

(b) Enlist any four limit states of collapse.

(c) Draw labelled sketches of Tee, Channel, angle and hollow circular steel sections with meaning of each notation.

(d) Define gross-section yielding with sketch and write formula for it for tension member as recommended by IS 800-2007.

(B) Attempt any ONE of the following : **6**

(a) 100 mm × 10 mm and 100 mm × 8 mm plates are connected by using 16 mm diameter bolt of grade 4.6 and grade of steel plate is 410 N/mm^2. Provide single row of bolts, find strength of joint. Find number of bolts required to form joint, Assume $k_b = 0.49$.

(b) Draw sketches of three different modes of failure in tension members of steel structure.

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

(a) An ISA 80 × 50 × 8 mm is to be connected to 10 mm thick gusset plate using 6 mm fillet weld. The angle is subjected to 150 kN tensile load, assume shop welding. Provide welds at extremities of the longer legs.

For ISA 80 × 50 × 8, take $C_{xx} = 27.3$ mm

(b) A double angle discontinuous strut carrying factored load of 140 kN. The length of strut is 4 m between intersections. The two angles are placed back to back on opposite side of 12 mm thick gusset plate. Tack bolts are provided, design the section. Assume $F_y = 250\ N/mm^2$ & kL = 0.85 L

Designation	**Weight (N/m)**	$\gamma_{min} = \gamma_{xx}$	**Area (A) mm_2**
ISA 70 × 70 × 6 mm	68 N/m	21.4 mm	806 mm^2
ISA 90 × 90 × 6 mm	82 N/m	27.7 mm	1047 mm^2

(c) A beam 5 m effective span, carrying a factored UDL of 45 kN./m on entire span (excluding self weight) and concentrated factored load of 15 kN at mid span. Design a laterally supported beam.

Designation	Wt/m	b_f mm	t_f mm	t_w mm	r_1 mm	Z_{xx} (mm^3)	I_{xx} (mm^4)	Z_p (mm^3)
ISMB350	514 N/m	140	14.2	8.1	14	778.9×10^3	1360.3×10^4	889.57×10^3
ISWB300	472 N/m	200	10	7.4	11	654.8×10^3	9821.6×10^4	731.21×10^3
ISMB400	604 N/m	140	16	8.9	14	1022.9×10^3	20456.4×10^4	1171.22×10^3

3. Attempt any FOUR of the following : $4 \times 4 = 16$

(a) Define lap and butt bolted joint along with their sketches.

(b) Draw detailed sketches of single V-butt weld & fillet weld.

(c) Draw sketch of truss and show eight important components of truss.

(d) Define pitch, principal rafter, main tie and spacing of truss.

(e) A pratt roof truss has spacing of 4.1 m, panel length 2.1 m, pitch ¼ and span 16.4 m. No access provided to roof, calculate panel point live load.

4. (A) Attempt any THREE of the following : 12

(a) Draw labelled sketches of any four types of built up compression member.

(b) Define slenderness ratio & radius of gyration and write formula also.

(c) A single angle discontinuous strut, 100 × 100 x 10 mm has effective length of 3000 mm, end connections are made by 4 bolts of 20 mm diameter and 4.6 grade. Assume $F_y = 250$ N/mm^2, $k_1 = 0.2$, $k_2 = 0.35$, $k_3 = 20$ and imperfection factor $\alpha = 0.49$ for ISA 100 × 100 × 10 mm, $A = 1903$ mm^2, $\gamma_{min} = 19.4$ mm. Find design compressive load.

(d) A strut 2ISA 100 × 100 × 6 mm, 2.8 m long connected to 10 mm thick gusset plate on either side by two bolts at each end. Determine compressive load carrying capacity of angle strut. For ISA 100 × 100 × 6 mm, $A = 1167\ mm^2$

$I_{xx} = I_{yy} = 111.3 \times 10^4\ mm^4$, $C_{xx} = C_{yy} = 26.76$ mm

(B) Attempt any ONE of the following : 6

(a) An ISA 125 × 75 × 8 mm is connected to 10 mm thick gusset plate by 4 bolts, 18 mm diameter. Assume $F_y = 250\ N/mm^2$ and $F_u = 410\ N/mm^2$ for ISA 125 × 75 × 8 mm, $Ag = 1538\ mm^2$. Determine tensile strength of angle section.

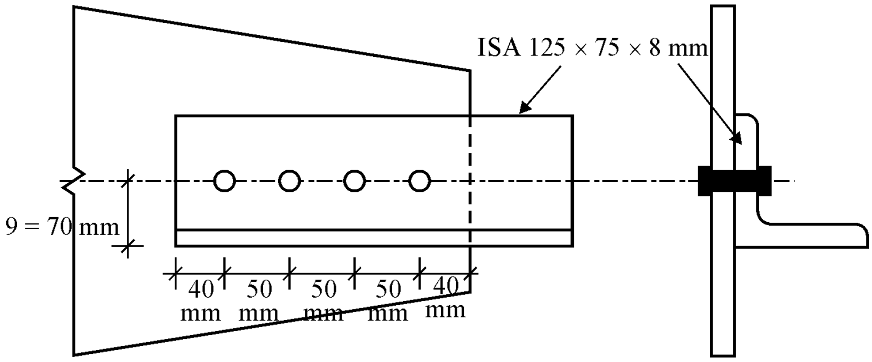

Figure 4(a)

(b) An unequal angle section used as a tie member, carrying 125 kN factored load, connected to 12 mm thick gusset plate by 20 mm diameter bolt. The design strength of 20 mm diameter bolt is 45.3 kN, assume edge distance as 2d, pitch as 2.5 dn and g = 60 mm.

Design the tension member. d = 20 mm, diameter of bolt and dn diameter of bolt hole.

Designation	Area in mm2	wt (kg/m)
ISA 100 × 75 × 6	1014	8
ISA 100 × 75 × 12	1956	15.4

5. Attempt any TWO of the following : 16

(a) A truss has following details :

Type of truss : Howe, span = 14.4 m, Rise = 3.5 m, panel point = 8 Nos., Spacing of truss = 3.5 m c/c, Weight of roof covering = 150 N/m^2, Weight of purlin = 80 N/m^2, Weight of bracing = 22 N/m^2, Coefficient of external. Wing pressure (Cpe) = –0.5 Pd, coefficient of internal wind pressure (Cpi) = ± 0.2 Pd Design wind pressure Pd = 1200 N/m^2 and Self-weight of truss = $\left(\frac{L}{3}+5\right) \times 10$ N/m^2.

Find dead, live and wind load per panel point.

(b) Design an unequal angle purlin for truss with span = 6m, Rise = 3m, Spacing of truss = 4 m c/c, panels = 6 Nos., Dead load = 150 N/m^2, Live load = 350 N/m^2 and wind load = 750 N/m^2. Apply checks as per IS 800-2007.

Designation	**wt N/m**	**I_{xx} (mm^4)**	**C_{xx} in mm**
ISA 100 × 65 × 6	74	96.7×10^4	31.9
ISA 100 × 75 × 6	78	100.9×10^4	30.1
ISA 90 × 90 × 6	67	70.6×10^4	28.7

(c) A column ISHB 350 @ 724 N/m carrying a factored load of 1505 kN. The column rests on slab base and slab base rest on concrete pedestal. Assume F_y = 250 N/mm^2, F_u = 410 N/mm^2, F_{ck} = 20 N/mm^2 (M20), γ_{mo} = 1.1 and SBC (Safe Bearing Capacity) = 150 kN/m^2. For ISHB 500 section b_f = 250 mm and t_f = 11.6 mm.

6. Attempt any FOUR of the following : 16

(a) State the different sections used for steel beam as per IS 800 code along with their two features of each.

(b) What is Laterally supported beam ? Draw two types of Laterally supported beam of each.

(c) An ISMB 250 is used as a simply supported beam of span 3 m to carry factored load of 30 kN/m, assume $f_y = 250$ N/mm^2. For ISMB 250, tw = 6.4 mm & h = 250 mm, check for shear only.

(d) Draw plan and sectional elevation of gusseted base by showing components of each.

(e) Write any four differences between slab base & gusseted base of column base.

IS : 800-2007 Equations (Formula Sheet)

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

$$T_{dg} = \frac{A_g f_y}{\gamma_{m0}} \ , \qquad V_{npb} = 2.5 k_b \, d \, t \, f_u$$

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

≥ 0.7

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

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

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

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

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

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

Values of χ and fcd (N/mm²) 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