17505

11718

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 values of $f_y, f_u, \gamma_{mo}, \gamma_{mw}$ *if not given in question.*
(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**. **12**

a) State any four advantages of steel as a construction material.

b) Define :

I) Importance factor II) Zone factor

III) Response reduction factor IV) Fundamental natural period

c) List the values of partial safety factor for material strength in case of resistance by yield, buckling, ultimate stress and bolt connection.

d) Explain shear lag.

B) Attempt **any one**. **6**

a) Determine bolt value 16 mm diameter bolt of 4.6 grade to connect two angles 90 × 60 × 06 mm back to back on opposite side of gusset plate of 8 mm thick. Also determine no. of bolts required for the joint when it carries direct factored load of 110 KN. Draw neat sketch of designed connection.

b) For a tension member as shown fig. 1. Determine block shear strength. f_y = 250 MPa, f_u = 410 MPa.

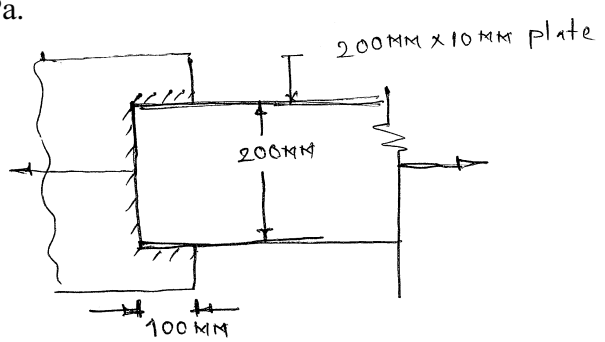

Fig. 1 [Q. 1 (B) b]

P.T.O.

Marks

2. Attempt **any two**. **16**

a) Design suitable fillet welded connection for ISA 80 × 50 × 08 mm with its longer leg connected to gusset plate of thickness 8 mm. The angle is subjected to factored load of 300 KN. C_{xx} = 27.3 mm. Assume weld applied to all three edges and shop weld.

b) A built up column consist of 2ISMC – 225, placed face to face at 120 mm. The distance is between their centres. The length of column is 6.0 m and both end are hinged. Find design strength of column.
For single ISMC – 225
A = 3301 mm^2, $I_{YY} = 1.872 \times 10^6$ mm^4,
$I_{XX} = 26.946 \times 10^6$ mm^4, C_{XX} = 23.1 mm. (Refer table no. 1 for f_{cd})

c) An ISMB 400 @ 604.3 N/m is used as simply supported beam of span 5.0 M. The compression flange of the beam is laterally supported throughout the span. Determine design flexural strength of member. Also calculate working udl on the beam per meter span. Check the member for deflection.
Take $Z_p = 1176.18 \times 10^3$ mm^3, $\gamma_{mo} = 1.1$, $\beta_b = 1.0$, $f_y = 250$ MPa

3. Attempt **any four**. **16**

a) Explain any two types of failure of bolted joints with neat sketches.

b) List types of bolts and sketch any one of them.

c) Write the IS code provision for design of angle purlin.

d) List the factors to be considered in calculation of wind load. Write equations to calculate wind load on roof truss as per IS 875-1987.

e) Draw a neat labelled sketch of angle purlin with principle rafter at panel point having roof covering as A.C. sheets.

4. A) Attempt **any three**. **12**

a) State with sketch the effective length for a compression member as per IS 800/2007 having end conditions as
i) Translation restrained at both ends and rotation free at one end.
ii) Translation and rotation restrained at both ends.

b) Draw neat sketch of lacing and battening. Also state function of same.

c) Explain "Limits of width to thickness ratio to prevent buckling for a single angle strut. The limiting width to thickness ratio for a semi-compact class is 15.7 C. Check whether ISA 90×90×06 mm is semi-compact class or not f_y = 250 MPa.

d) What is local buckling in case of compression member ? What is its effect ? What is to be done to prevent it ?

B) Attempt **any one**. **6**

a) Explain gross section yielding and net section rupture in case of design strength of tension member. Also write two measures taken to prevent rupture.

Marks

b) Design tension member consisting of single unequal angle connected to gusset plate of 12 mm thk. to carry a factored tensile load of 300 KN. Assume single row of 20 mm bolted connection. The length of the member is 2.5 m.
Take f_u = 415 MPa = 0.80

Section (mm)		Area (mm^2)
ISA	100×75×8	1336
	125×75×8	1588
	150×75×8	1748

5. Attempt **any two**. **16**

a) A hall of size 12 m × 20 m is provided with Howe type roof trusses at 4 m c/c. Calculate panel point load in case of DL and LL for following data –
i) unit wt. of roof covering = 165 N/m^2
ii) self wt. of purlin = 100 N/m^2
iii) wt. of bracing = 60 N/m^2
iv) rise to span ratio = 1/5
v) total no. of panels = 08

b) A industrial building has trusses for 14 m span. Trusses are spaced at 3.5 m c/c and rise of truss is 3.50 m. Calculate panel point load in case of live load and wind load using following data –
i) Coefficient of external wind pressure (C_{pe}) = – 0.7
ii) Coefficient of internal wind pressure (C_{pi}) = ± 0.2
iii) Design wind pressure = 1200 N/m^2
iv) No. of panels = 08

c) A column ISMB – 300 carries an axial load of 1.5 MN. Design a slab base and concrete pedestal for the column. Take SBC of soil as 200 KPa and M20 grade of concrete is used for concrete pedestal. For ISMB – 300 consider b_f = 140 mm, t_f = 13.1 mm. Take f_y = 250 MPa, $\gamma_{mo} = 1.1$.

6. Attempt **any four**. **16**

a) Define – laterally supported beam along with suitable sketch. State any three methods of providing lateral support to the beam.
b) State four classification of c/s of beam based on moment-rotation behavior as per IS – 800/2007.
c) An ISMB – 250 is used for simply supported span of 4 m to carry a factored load of 30 KN/m. Check the section for shear only. Take f_y = 250 MPa, t_w = 6.4 mm.
d) Draw plan of gussetted base showing all components.
e) Write steps to calculate the thickness of base plate used in slab base. Why anchor bolts are used in slab base.

Table – 1 : Values of design compressive stress (f_{cd}) for f_y = 250 MPa.

KL / r (SR)	40	50	60	70	80	90	100	110	120	130	140
$\mathbf{f_{cd}}$	198	183	168	152	136	121	107	94.6	83.7	74.3	66.2

Marks

IS:800-2007 Equations (Formula Sheet)

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

$$T_{dg} = \frac{A_g f_y}{\gamma_{m0}} \ , \ T_{dn} = \frac{0.9 f_u A_n}{\gamma_{m1}} \qquad V_{npb} = 2.5 k_b d t f_u \qquad k_b = \left[\frac{e}{3d_0}, \frac{p}{3d_0} - 0.25, \frac{f_{ub}}{f_u}, 1.0\right]$$

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

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

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

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

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

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

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

$$M_z = \frac{\beta_b \cdot Z_p \cdot f_y}{\gamma_{mo}}$$

$$V_{dz} = \frac{f_y \times t_w \times h}{\gamma_{mo}\sqrt{3}}$$

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

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