17505

15162

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

Instructions : *(1)* ***All*** *questions are* ***compulsory****.*
(2) Illustrate your answers with neat sketches ***wherever*** *necessary.*
(3) Figures to the ***right*** *indicate* ***full*** *marks.*
(4) Assume suitable data, if ***necessary****.*
(5) Use of Non-programmable Electronic Pocket Calculator is ***permissible****.*
(6) Formula sheet is allowed.

Marks

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

a) What are the types of loads to be considered while designing the steel structures ?

b) Draw any four types of structural steel sections.

c) Define Limit state and state different types of limit states.

d) State with sketch different single and built-up sections of structural steel members used as tension member.

B) Attempt **any one** : **(1×6=6)**

a) Design a suitable fillet weld to connect a tie bar 80 mm × 8 mm to 10 mm thick gusset plate. Design the joint for full strength of the tie and assume welding on all three sides as shown in figure no. 1

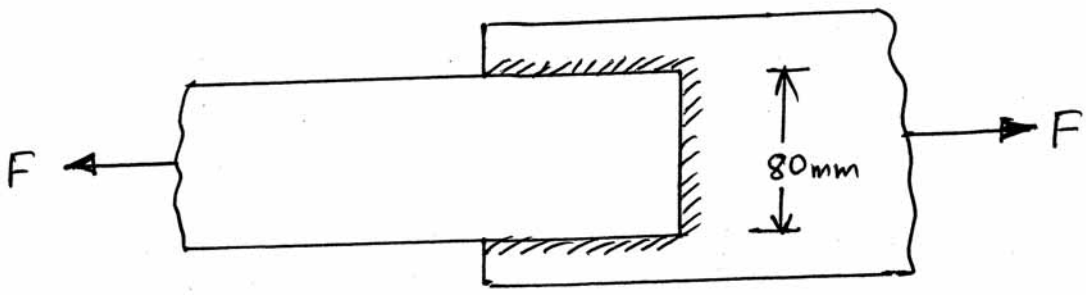

Figure No. 1

Take f_y = 250 MPa, $\gamma_{mo} = 1.1$ and f_u = 410 MPa

b) Two ISA 80×80×6 is connected back to back on either side of 10 mm thick gusset plate using fillet weld. Determine tensile strength of member from yield criterion only. for ISA 80×80×6, A_g = 929 mm^2 C_{zz} = 21.8 mm. Take f_y = 250 MPa, $\gamma_{mo} = 1.1$ and f_u = 410 MPa.

P.T.O.

Marks

2. Attempt **any two** : **(2×8=16)**

a) A lap joint consists of two plates of 100 mm×10mm connected by 20mm dia. bolts of grade 4.6. All bolts are in one line. Calculate strength of single bolt and number of bolts to be provided in the joint.

b) A discontinuous compression member consists of 2 ISA 90×90×10 mm connected back to back on opposite sides of 12 mm thick gusset plate and connected by welding. The length of strut is 3 m. It is welded on either side. Calculate design compressive strength of strut. For ISA 90×90×10, $C_{xx} = C_{yy} = 25.9$ mm $I_{xx} = I_{yy} = 126.7\times10^4$ mm^4, $r_{zz} = 27.3$ mm values of fed are

KL/r	90	100	110	120
fed (N/mm²)	121	107	94.6	83.7

c) Check whether ISMB250@37.4 kg/m is suitable or not as a simply supported beam over an effective span of 6 m. The compression flange of beam is laterally supported throughout the span. It carries udl of 15 kN/m (including self wt.). Properties of ISMB 250 are $b_f = 125$ mm, $t_f = 12.5$ mm, $t_w = 6.9$ mm, $I_{xx} = 5131.6\times10^4$ mm^4, $Z_{xx} = 410\times10^3$ mm^3, $r_1 = 13.0$ mm, $z_{px} = 465.71\times10^3$mm^3, $\gamma_{mo} = 1.1$, $\beta_b = 1$ and $f_y = 250$ MPa.

3. Attempt **any four** : **(4×4=16)**

a) State any modes of failure of bolted joints.

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

c) Draw neat sketches of HOWE and NORTH LIGHT trusses. Mark panel, panel point, rafter and tie in any one truss.

d) Draw neat sketch of six panel truss showing main tie, principle rafter, pitch and span. Also state any two uses of steel roof truss.

e) What is purlin ? State IS : 800 – 2007 procedure for design of angle purlin.

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

a) Sketch different cross sections used for compound struts and built up columns.

b) State effective length for a compression member having and conditions as

i) Restrained against translation and free against rotation at one end but roller supported at the other end.

ii) Restrained against translation and free against rotation at both ends.

c) Draw neat sketch showing single lacing system. Why lacing is used ?

d) Limiting width to thickness ratio for single angle strut of semi-compact class is $15.7\in$. State whether ISA is 100×100×6 is of semi-compact class or not. Take $f_y = 250$ MPa.

Marks

B) Attempt **any one** : **(1×6=6)**

a) State and explain three modes of failure of axial tension member.

b) Design a suitable angle section as a tie member in a truss to carry factored load of 215 kN. Use double angle section connected back to back on either sides of 12 mm thick gusset plate by means of 4 – 20 mm dia. bolts in one line. Assume design strength of 20 mm dia. Bolt = 45.3 kN, α =0.8, β =1.08 γ_{mo} = 1.1, γ_{m1} = 1.25, f_y = 250 MPa, f_u = 410 MPa.

Available sections	**Gross Area (mm^2)**
ISA 80×50×8	978
ISA 100×75×6	1014
ISA 125×75×6	1166

5. Attempt **any two** : **(2×8=16)**

a) A hall of size 12m×18 m is provided with Fink type trusses at 3 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 weight of purlin = 220 N/m^2

iii) Weight of bracing = 80 N/m^2

iv) Rise to span ratio = 1/5

v) No. of panels = 6

b) An industrial building has trusses for 14 m span. Trusses are spaced at 4m c/c and rise of truss is 3.6m. Calculate panel point load in case of live load and wind load using following data :

i) Coefficient of external wind pressure = – 0.7

ii) Coefficient of internal wind pressure = $\pm$ 0.2

iii) Design wind pressure = 1.5 kPa

iv) Number of panels = 08

c) Design a slab base for column ISHB 400 @ 82.2 kg/m to carry factored axial compressive load of 2000 kN. The base rests on concrete pedestal of grade M_{20}.

For ISHB 400, b_f = 250 mm, f_y = 250 MPa, f_u = 410 MPa, γ_{mo} = 1·1, t_f = 12.7 mm.

6. Attempt **any four** : **(4×4=16)**

a) For a beam ISWB600, section is insufficient. Suggest suitable remedy with sketches.

b) State classification of cross sections of beams based on moment rotation behaviour.

c) What is plate girder ? Write functions of web plate and bearing stiffeners.

d) Draw neat labeled plan and sectional elevation of gusseted base.

e) What is the basic concept of deciding the plan area of slab base and concrete block below it ? State the function of cleat angle and anchor bolt in case of slab base.

Marks

IS:800-2007 Equations (Formula Sheet)

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

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

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

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

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

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

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

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

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

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