T.Y. Diploma : Sem. V
[CE/CR/CS/CV]

Design of Steel Structures

Time: 4 Hrs.] Prelim Question Paper **[Marks : 100**

Instruction : (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.

1. (a) Attempt any **THREE** of the following : **[12]**

(i) State objectives and factors to consider by a designer in designing steel structure.

(ii) Explain the limit states of serviceability applicable to steel structure.

(iii) List the values of partial safety factors for material strength in case of resistance by-yield, buckling, ultimate stress and bolt connection.

(iv) Explain what do you mean by shear lag.

(b) Attempt any **ONE** of the following : **[6]**

(i) Design the Lap joint for the plates of sizes 100 × 16 mm and 100 × 10 mm thick connected so as to transmit a factored load of 100 kN using single row of 16 mm diameter bolts of grad 4.6 and plate of 410 grade.

(ii) Draw neat sketches of bolted connections in case of :
(1) Beam to Beam connection when flanges are at same level.
(2) Beam to Beam connection when flanges are not at same level.
(3) Beam to column connection.

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

(a) A lap joint consists of two plates 200 × 12 mm connected by means of 20 mm diameter bolts of grade 4.6. All bolts are in one line. Calculate strength of single bolt and no. 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 $I_{xx} = I_{yy} = 126.7 \times 10^4$ mm^4, $r_{zz} = 27.3$ mm values of fed are

KL/r	90	100	110	120
fed (N/mm^2)	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, $I_{xx} = 5131.6 \times 10^4$ mm^4, $Z_{xx} = 410 \times 10^3$ mm^3, r_1 = 13.0 mm, $z_{px} = 465.71 \times 10^3$mm^3, $\gamma_{mo} = 1.1$, $\beta_b = 1$ and $f_y = 250$ MPa.

3. Attempt any **FOUR** of the following : **[16]**

(a) State types of bolted joints and types of failure in case of bolted joints.

(b) State two advantages of welded joints and two disadvantages of bolted joints.

(c) Draw sketches of Howe type and Pratt type truss showing pitch, rise, panel point, panel, principal rafters and all members in one of the above types.

(d) State different types of loads and its combination considered during design of roof truss. Explain in brief any one of them along with its relevant IS Code.

(e) Draw a neat sketch and label of an angle Purlin with principal rafter at Panel Point having root covering is A.C. sheets.

4. (a) Attempt any **THREE** of the following : **[12]**

(i) Sketch different sections used as built-up strut and built-up column.

(ii) State with a sketch the effective length for a compression member as per IS 800 – 2007 having end conditions as

(1) Translation restrained at both ends and rotation free at both ends.

(2) Translation and rotation restrained at both ends.

(iii) State the function of lacing and battening.

(iv) Limiting width to thickness ratio for single beam section of plastic class is 9.4 and d/tw = 84. State whether ISMB 500 @ 852 N/m is of plastic class or not. For ISMB 500 h = 500 mm, b_f = 180 mm, t_f = 17.2 mm, t_w = 10.2 mm, r_1 = 17.0 mm, f_y = 250 MPa.

(b) Attempt any **ONE** of the following : **[6]**

(i) Find the value of permissible stress in axial tension (6 at) for f_y = 250 MPa. State why unequal angles with long legs connected are more efficient?

(ii) Design a tension member consisting of single unequal angle section to carry a tensile load of 340 kN. Assume single row 20 mm bolted connection. The length of member is 2.4 m. Take – f_u = 410 MPa, α = 0.80

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

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

(a) A hall of size 12m × 18m 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 in 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 = ± 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** of the following : **[16]**

(a) Write steps to calculate the thickness of base plate used in slab base. Why anchor bolts are used in slab base.

(b) Differentiate between Laterally supported and unsupported beams with a neat sketch.

(c) Define Gusseted base. Also draw its labelled sketch showing all details.

(d) How beam sections are classified for bending as per IS : 800 – 2007. Describe any two of them.

(e) A simply supported beam of 6 m span supports on R. C. C. slab where in comp flange is embedded. The beam is subjected to a dead load of 25 kN/m and super imposed load of 20 kN/m, over entire span. Calculate plastic and elastic modulus required.
Assume r_f = 1.5, γ_m = 1.1 f_y = 250 N/mm^2.

Paper Discussion Schedule for T.Y. Diploma (Sem. V)

Date	Day	Timing	Centres
14 Nov. 2016	Monday	9 a.m. to 11 a.m.	Thane

❑ ❑ ❑ ❑ ❑