WEST BENGAL UNIVERSITY OF TECHNOLOGY

CE-602

DESIGN OF STEEL STRUCTURE

Time Allotted: 3 Hours   Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as
practicable. All symbols are of usual significance.

GROUP A
(Multiple Choice Type Questions)

1.   Answer any *ten* questions. $10 \times 1 = 10$

   (i) The shear strength of the bolt can be written as $f_s.A_n$, where f_s is given by

   (A) $\dfrac{f_y}{(\sqrt{3} \times 1.25)}$ (B) $\dfrac{f_u}{(\sqrt{3} \times 1.25)}$

   (C) $\dfrac{f_y}{(\sqrt{3} \times 1.10)}$ (D) none of these

   (ii) The design nominal strength of a fillet weld is

   (A) f_u (B) $\dfrac{f_u}{\sqrt{3}}$,   (C) f_y (D) $\dfrac{f_u}{\sqrt{3}Ymw}$

(iii) As per working stress method (IS 800 : 2007), permissible tensile stress for yielding of gross section of a 24 mm thick mild steel gusset plate will be

(A) 138 MPa   (B) 144 MPa

(C) 150 MPa   (D) 250 MPa

(iv) Web crippling in steel beam occurs due to

(A) column action of compression flange

(B) failure of web under concentrated load

(C) excessive bending moment

(D) secondary bending moment

(v) Intermediate vertical stiffeners are provided to

(A) eliminate web bucking

(B) eliminate local buckling

(C) transfer concentrated load

(D) prevent excessive deflection

(vi) What is the value of the imperfection parameter (α_{LT}) for rolled steel sections to calculate the bending strength of laterally unsupported beams?

(A) 0.21   (B) 0.49

(C) 1.0   (D) 1.2

(vii) As per IS: 800–2007, what is the maximum effective slenderness ratio for a member carrying compressive loads resulting from dead and imposed loads?

(A) 250   (B) 300

(C) 180   (D) 400

(viii) A single angle member connected through one leg only is used as a tension member. The Yield and Ultimate stresses for the angel section are 250 MPa and 410 MPa respectively. What is the maximum value of shear lag parameter (β) for this angle section

(A) 1.24　　　　　　　　　(B) 1.44

(C) 1.40　　　　　　　　　(D) 0.7

(ix) What is the effective length of a column of length 'L' with both ends restrained against rotation but held in position at one end only?

(A) 1.2L　　　　　　　　(B) 1.0L

(C) 2.0L　　　　　　　　(D) 0.65L

(x) What is the maximum inclination of a lacing bar according to IS: 800 – 2007?

(A) 80°　　　　　　　　　(B) 40°

(C) 70°　　　　　　　　　(D) 45°

(xi) What is the maximum outstand of web stiffener of thickness 't_q'?

(A) 20 $t_q\varepsilon$　　　　　　　(B) 10 $t_q\varepsilon$

(C) 8 $t_q\varepsilon$　　　　　　　(D) 100 $t_q\varepsilon$

(xii) Two plates of different thicknesses are to be connected using a single run fillet weld. Which of the following parameter determines the minimum size of the fillet weld as per the guidelines of IS: 800-2007?

(A) Thickness of the thinner plate
(B) Thickness of the thicker plate
(C) Ultimate strength of the plate
(D) Yield strength of the plate

GROUP B
(Short Answer Type Questions)

Answer any *three* questions.   3×5 = 15

2. An ISA 100 × 100 × 10 mm angle is to be welded in shop to a 12 mm thick gusset plate. The angle carries an ultimate pull of 325 kN applied along its centroidal axis. Determine the length of the side fillet welds required at the heel and toe of the angle.

3. An ISHB 400 @ 806.4 N/ m is to be used as a column 5 m long with both ends restrained against translation and rotation. Determine the design compressive load for the column. Use Fe 410 grade steel.

4. Design a slab base for a column ISHB 350 @ 710.2 N/m subjected to an axial compressive load of 1500 kN. Load is transferred to the base plate by direct bearing of column flanges. Take f_u = 410 MPa, f_y = 250 MPa.

5. Two plates 200 × 8 mm of grade Fe410 are connected by 200 mm diameter bolts of grade 4.6 using butt joint. Design the bolted connection to transmit a pull equal to the strength of the plate. Also show the arrangement of bolts in the joints through a sketch.

6. An equal angle 1.5 m long is connected to a gusset plate. It carries an ultimate tension of 250 kN. Design the section
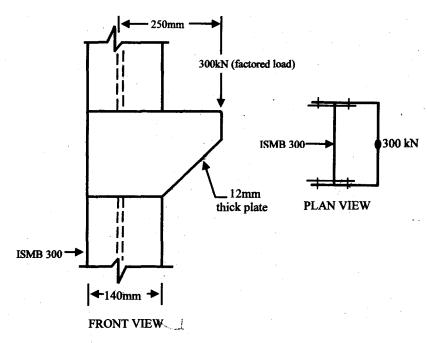   (i) Using bolted connection and
    (ii) Using 4 mm weld.   ,

GROUP C
(Long Answer Type Questions)

Answer any *three* questions.   3×15 = 45

7. Design the bolted connection as shown in figure below. The connection is to be designed to transfer a factored load 300 kN. The eccentricity of load from the cg of the column is 250 mm. The Yield and Ultimate strengths of the material are 250 MPa and 410 MPa respectively. The bolts are of grade 4.6. The thickness of the bracket plate is 12 mm and the column section is ISMB 300 @ 44.2 kg/m.

8. A purlin is to be designed to support elastic cladding such as GI sheet as roof material for trusses spaced at 4.5 c/c. Purlins, along principal rafter, are arranged at a distance of 1.35 c/c. The pitch of the truss is 0.2m. Design a section for the purlin. Assume basic wind speed as 50 m/s.

9. Design a built-up column using lacing bars to carry a factored axial compressive load 1000 kN and factored uni-axial moment 80 kN.m acting at the base of the column. The effective length of the column is 8.0 m. Design the connections using fillet welds. The Yield and Ultimate strengths of the material are 250 MPa and 410 Mpa respectively.

10. Design a welded plate girder of effective span 30m, carrying an uniformly distributed load of 40 kN/m and two concentrated loads of 150 kN each, acting at a distance 10m from both ends. The girder is simply supported at its ends. It is fully restrained against lateral buckling throughout the span.

11. A gantry girder for an EOT crane is provided with a section consisting of ISWB 300 on its top with flanges down. Check the suitability of the girder section against factored bending moment due to dead load, live load and impact load amounting to 800 kN.m and factored S.F of 600 kN.