# Code : 011620

## B.Tech 6th Semester Exam., 2016

## DESIGN OF STEEL STRUCTURES

*Time* : 3 hours *Full Marks* : 70

*Instructions* :

*(i) The marks are indicated in the right-hand margin.*

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

**1.** Write short answers of the following (any *seven*) : 2×7=14

*(a)* Define and differentiate between pitch and gauge for riveted joint.

*(b)* Find the shape factor for square of side *a* with its diagonal parallel to the *zz*-axis.

*(c)* Find the rivet value for 20 mm dia power-driven rivets which are connecting two plates of thickness 14 mm and 16 mm by lap joint.

*(d)* Draw the bending stress diagram under a column base which is subjected to a point load *p* at an eccentricity *e*.









*(e)* An I-section beam is fabricated with plates of the following dimensions :

Flanges : 600 mm × 20 mm
Web : 1600 mm × 12 mm

Classify flanges, web and the section. Also determine the plastic moment capacity of the beam about its strong axis, if the grade of steel is Fe 410.

*(f)* Draw a roof truss and label the following members on it :

*(i)* Upper chord member

*(ii)* Lower chord member

*(iii)* Principal rafter

*(g)* A continuous beam of constant $M_p$ has three equal spans and carries total uniformly distributed load W on each span. Find the value of collapse load for the beam.

*(h)* For a welded plate girder with vertical stiffeners, what is the maximum depth of web provisionable in design when the thickness of the web plate is 5 mm?

*(i)* What are laterally supported and unsupported beams?

*(j)* Why is curtailment of flanges carried out in the design of a plate girder?

2. *(a)* A tie member consisting of an ISA 80 mm × 50 mm × 8 mm (Fe 410 graded steel) is welded to a 12 mm thick gusset plate at site. Design welds to transmit load equal to the design strength of the member. 12

*(b)* Concave shape fillet welds are avoided. Comment. 2

3. Find out the collapse load for a propped cantilever subjected to a uniformly distributed load $W$/unit length over its entire span. 14

4. *(a)* Explain the defects in welded connections with appropriate figures. 3

*(b)* Two plates, 10 mm and 18 mm thick, are to be jointed by double-cover butt joint. Design the joint for the following data : 11

| | | |
|---|---|---|
| Factored design load | : | 750 kN |
| Bolt diameter | : | 20 mm |
| Grade of steel | : | Fe 410 |
| Grade of bolts | : | 4.6 |
| Cover plates 2 (One on each side) | : | 8 mm thick |

5. A tension member 0·95 m long is to resist a service dead load of 20 kN and a service live load of 60 kN. Design a rectangular bar of standard structural steel of grade Fe 410. Assume that the member is connected by one line of 16 mm diameter bolts of grade 4·6. 14









6. Design a built-up column 10 m long to carry factored axial load of 1080 kN. The column is restrained in position but not in direction at both the ends. Provide single lacing system with bolted connections. Assume that steel is of grade Fe 410 and bolts are of grade 4·6.

*(a)* Design the column with two channels placed back-to-back.

*(b)* Design the column with two channels placed toe-to-toe.

*(c)* Which of the two systems is economical? 14

7. An ISLB 300 @ 369·8 N/m transmits an end reaction of 385 kN, under factored loads, to the web of ISMB 450 @ 710·2 N/m. Design a bolted framed connection. Steel is of grade Fe 410 and bolts are of grade 4·6. 14

8. *(a)* Determine the design bending strength of ISLB 350 @ 486 N/m considering the beam to be laterally supported. The design shear force $V$ is less than the design shear strength. The unsupported length of the beam is 3·0 m. Assume that steel is of grade Fe 410. 7

*(b)* A simply supported steel joist of 4·0 m effective span is laterally supported throughout. It carries a total uniformly distributed load of 40 kN (inclusive of self-weight). Design an appropriate section using steel of grade Fe 410. 7



( Continued )

9. Design the principal rafter of a fink-type roof truss for the following data. Design also its connection using 20 mm diameter bolts : 14

Design compressive load—
165 kN (due to D.L. and L.L.)

Design tensile load—
60 kN (due to D.L. and W.L.)

Length of rafter panel—2·235 m
Grade of steel—Fe 410
Grade of bolts—4·6

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